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THE FERTILIZATION OF SALVIA SPLENDENS BY BIRDS.[1]

BY WILLIAM TRELEASE.

IN the fall of 1878, while studying the structure of various flowers, as correlated with the mode of their fertilization, I examined *Salvia splendens* Sellow,[2] a Brazilian species very commonly cultivated for its large scarlet flowers. From the structure as then made out, I was partially convinced that I was not dealing with an entomophilous flower; but it was not until two years later that I had an opportunity to look into the matter any further, and I then became certain that the species was one of the more closely adapted ornithophilous plants.

The flowers, arranged in a compound raceme, are placed horizontally or nearly so. Nectar, secreted by a large, lobed disk (*n*), as usual in the Labiatæ, accumulates in the basal part of the corolla, and offers a considerable amount of tempting food to nectar-loving creatures, and this, advertised by the brilliant scarlet of the calyx and corolla, clearly proclaims the flowers to be zoöphilous, or adapted to fertilization by animals of some kind.

The corolla is tubular, though somewhat laterally compressed, and reaches a length of not far from two inches. It possesses the bilabiate character which has given a name to the natural

[1] Read before the Boston Society of Natural History, Feb. 2, 1881.

[2] Professor F. Hildebrand, in his paper on the fertilization of Salvias by insects (Pringsheim's Jahrb. wiss. Bot., 1865, IV, p. 459, and Pl. 33, figs. 8 and 9), describes and figures the floral structure of a species to which he gives this name, but which is quite different from that on which my observations were made, which, it may be added, has been found to agree with authentic specimens of *S. splendens* in the Gray Herbarium.

order to which it belongs, and, as is generally the case with labiate flowers, the lower lip is split into three lobes, a median and two lateral, which in this case are of nearly equal size. Here, however, the lower lip—usually well developed and affording a convenient landing place for insects—is small and of little or no use for this purpose.

The style is exserted to a considerable distance, and the included portion is held quite firmly in a longitudinal fold of the upper part of the corolla tube. The forked stigma (*st*) is thus maintained in the median plane of the flower.

The stamens are two in number, and of the general form found in this genus. Their filaments are adherent to the corolla to within a short distance of its mouth, where they become free, and run obliquely upward and forward, terminating side by side, close beneath the base of the upper lip. The connective which in many flowers forms an inconspicuous band between the anther cells, is here prolonged, in each stamen, into a slender longitudinally-placed rod nearly an inch in length. Each connective (*c*) is attached at its middle by a hinge joint to the end of its filament, thus forming an oblique lever with equal arms, which lies with its anterior end *a* in contact with, or barely protruding from the tip of the arched upper lip of the corolla, while its posterior end *a'* nearly reaches the floor of the tube. If this were constructed as the stamens of related plants are, it should bear an anther cell at each end; but in reality only a single fertile cell—the anterior—is developed, the posterior cell being abortive. Moreover, the connectives of the two stamens are coherent for a short distance back of their insertion, so that the two form, in reality, a single forked lever.

When a flower first opens, the stigma is immature, its lobes being closely appressed, as shown in the upper part of Fig. 2, but the anthers are already dehiscent. In other words the species is proterandrous. Later, when some or all of the pollen has been removed, the stigmatic lobes expand, as shown in the lower part of Fig. 2, and expose the now receptive surfaces, and the style curves down into the position shown by the dotted line of Fig. 1. From my observations, I should say that the life of a given flower may be divided into three periods; in the first, the anthers only being mature, it is staminate in function; in the second, some pollen remaining in the anthers, while the stigmas

become receptive, it is functionally hermaphrodite or perfect; and in the third, the pollen having been entirely removed, while the

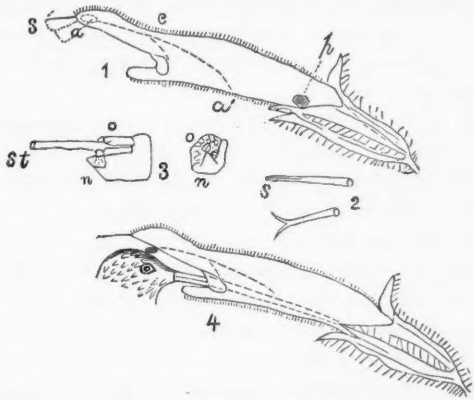

FIG. 1.—Young flower of *Salvia splendens*, seen from the side. The position of the connective and filament is shown by dotted lines, as also the position assumed by the style in older flowers. FIG. 2.—Stigmas; the upper from a newly expanded flower, the lower from a flower which has been open for some time. FIG. 3.—The nectar gland and ovary. FIG. 4.—A flower visited by a humming bird; Figs. 1 and 4 natural size; Figs. 2 and 3, enlarged four diameters; *a*, indicates the fertile anther cells; *a'*, the sterile cells; *c*, the connective, at the point where it is hinged to the filament; *n*, the nectar gland; *o*, the ovary; *p*, a perforation of the corolla, made by ants for access to the nectar; *s*, the stigma; *st*, the style.

stigma, if unfertilized, retains its freshness, it is pistillate only so far as function is concerned.

It appears at once that there is little likelihood of pollen reaching the stigma without some sort of assistance, and the proterandry decreases the chances for a given flower to be fertilized by its own pollen when such assistance is rendered, though from the apparent incompleteness of the dichogamy this may occur in some instances.

Many species of Salvia are perfectly adapted to profit by the visits of bees, usually humble bees, which, in entering the flower for nectar, encounter and elevate the posterior end of the connectives with their heads, thus bringing the polliniferous anterior end upon their backs and dusting them with pollen, which will be brushed off, in part, by the stigma of the next older flower visited. When the insect leaves the flower, the stamens, returning to their former position through the elasticity of the parts, are ready to make their bow to the next comer. Two facts, however, argue against the adaptation of the present species to bees:

1. The narrow and elongated tubular form of the corolla quite effectually excludes those which are large enough to set the lever in motion; 2. If such an insect, for instance a hive bee or small humble bee, should force its way into the tube, by the time its head had reached and elevated the sterile end of the lever, the tip of its abdomen would have passed the lowering polliniferous end, so that no pollen would reach the insect, and the object of the motion would be defeated. Bees might, to be sure, visit the flowers solely for their pollen, and I have no doubt that they occasionally do so, in which case they must often render some service in their fertilization, as is the case in so many flowers visited for pollen alone. Bees being excluded for the reasons above given, we turn to Lepidoptera, which sometimes visit the flowers, their long and slender proboscides enabling them to reach the nectar with little exertion; but it remains to be shown that these organs are sufficiently large or rigid to set the stamens in motion. Even if it should be shown that the large nocturnal moths do move the levers, which I am far from believing to be the case, the brilliant scarlet color is one ill adapted to rendering the flowers conspicuous in the twilight or night, and, so far as I know, one which is never possessed by flowers especially dependent upon these insects for their fertilization; beside which, we do not find that close constriction of the mouth or anterior part of the corolla bespeaking adaptation to the Lepidoptera. It appears, then, that when these insects visit the flowers of our sage, they may be of some use in transferring pollen, since their heads may encounter stigma and anthers, but they do this without rendering the motility of the latter of any value.

The only alternative, then, is birds, which, to be of the highest use in this connection, must be found in the native habitat of the plant, must visit flowers frequently for nectar, small insects attracted by the latter, or for both, and finally, must have slender and elongated beaks capable of insertion into the tubular flowers. All of these conditions are fulfilled by many of the humming birds, which reach their greatest number in both species and individuals in Equatorial America. The color of this Salvia is one of the most attractive to humming birds, and a glance at Figure 4 will show that one of those with an elongated beak cannot fail to operate the lever in the most perfect manner; its extensible tongue, however, rendering it by no means necessary for its beak to equal the corolla in length.

In a brief note published in the *Botanische Zeitung* for 1870, p. 275, Fritz Müller states that in Brazil the scarlet Salvias are frequently visited by birds, and although no species are named, there is little reason to doubt that the one under consideration was among those observed. Our single species of Trochilus, the ruby throat, possesses a beak rather short for the most efficient working of the staminal lever, yet from the statements of friends and from personal observation I can vouch for its frequently rendered service, and the greater part of the capsules of this plant which mature in our borders are to be credited to this active little creature.

Although this paper is confined to a single species of Salvia, it by no means follows that others may not offer examples of equal or even of greater adaptation to birds, and several such might be mentioned. The conclusion seems, on the whole, warranted, that several tropical American Salvias are as perfectly adapted to profit by the visits of birds as many other species of the genus are to profit by the visits of bees.

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ON THE ORIGIN OF THE FOOT STRUCTURES OF THE UNGULATES.

BY E. D. COPE.

THE following considerations have been suggested by a study of the primitive types of the odd and even-toed ungulates. I first, in 1874, recorded the opinion that the *Mammalia* with a reduced number of digits were derived from pentadactyle plantigrade types.[1] The ungulate order which fulfills this requirement is the *Amblypoda*, and from them, I doubt not, both the *Perissodactyla* and *Artiodactyla* have arisen, although not from any of the genera now known. Both of these great orders display a regular diminution in the number of the digits; in the former, by reduction and extinction on both sides of the third digit; in the latter, by reduction and extinction on each side of the third and fourth digits. Mr. John A. Ryder[2] has pointed out that reduction in digits is probably directly related to strains and impacts. He reminds us that the anterior digits are reduced in *Mammalia* of unusual scansorial or fossorial powers; while in forms which display

[1] Journal Academy Philadelphia, March, 1874.

[2] AMERICAN NATURALIST, October, 1877.

powers of running, the reduction is seen first in the posterior feet, which propel the body much more than the fore feet. This view is well illustrated in the Perissodactyle families, the majority of which have the digital formula 4—3.

No reason has ever been suggested, so far as I am aware, in explanation of the fact that one series of ungulates has retained two digits, and the other only one; that is, why there should have been two kinds of digital reduction instead of one kind. In seeking for an explanation, we will remember that the tarsus in the odd or single-toed line, is bound together by fixed articula-

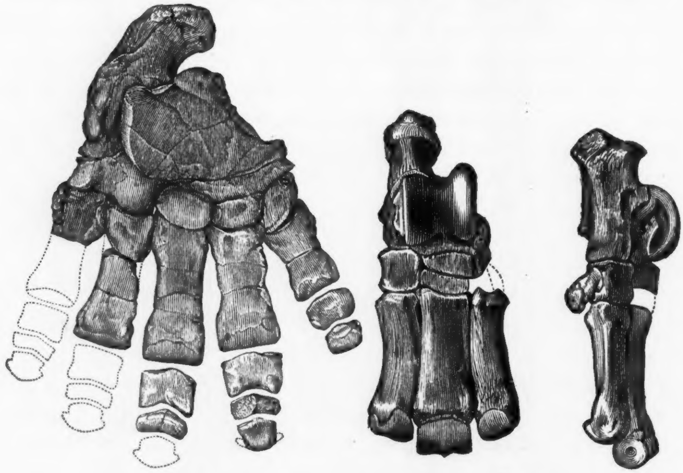

FIG. 1. FIG. 2.

FIG. 1.—Right posterior foot of a species of *Coryphodon* from New Mexico, one-half nat. size. From Report Expl. W. of 100th Mer. G. M. Wheeler, IV. Pl. LIX.

FIG. 2.—Right posterior foot of *Aphelops megalodus* Cope, from Colorado, one-half natural size. From Report U. S. Geol. Surv. Terrs. F. V. Hayden, IV, Pl. CXXX.

tions, while in the cloven footed line it is interrupted by the hinge between the first (astragalus), and second rows of bones. The hinge-joint being more liable to luxation than the fixed articulation, requires a wider basis of support, such as would be furnished by two divergent digits, rather than by a single central one.

In the early types, where the median digits are slender, the mechanical advantage in favor of the bidigital over the unidigital arrangement is much more obvious than in modern genera. Late in time, the horse developed the middle digit to such a width as to form almost as good a support as the bidigital structure. In

the Eocene genera, the slender median digit could not have sustained the weight on a hinge, without great risk of dislocation. This explanation it can be said, applies only to the posterior foot. The posterior foot has, however, led the way in the evolution of *Ungulata*, and the fore foot may have followed in accordance with the law of antero-posterior symmetry in growth. A curiously malformed deer from Mendocino county, Cal., throws some

FIG. 3.

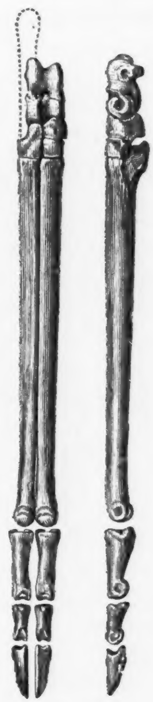

FIG. 4.

FIG. 3.—Right posterior foot of *Protohippus sejunctus* Cope, from Colorado, about one-half natural size. From Report U. S. Geol. Surv. Terrs. F. V. Hayden, IV.

FIG. 4.—Right posterior foot of *Poëbrotherium labiatum* Cope, from Colorado, three-fifths nat. size. From Hayden's Report, IV, Pl. CXV.

light on this subject. It has apparently a single functional digit on each foot. Examination shows that the posterior foot is bidigital, but that the phalanges are fused; while the anterior foot is perissodactyle, all the digits but the third being rudimen-

tal! Similar evidence is furnished by the genus *Eurytherium* of the French Eocene. Its posterior foot is modified artiodactyle, while the anterior is modified perissodactyle. We may assume from these facts, that the posterior foot is more subject to the influences which tend to produce the bidigital structure than is the anterior limb.

I suspect that the production of a ginglymus in the middle of the tarsus, has been due to the use of the posterior limb in soft swampy ground. In the absence of this condition, as in a life on harder ground than swamp, no ginglymus would be formed. The action of an ungulate in walking through deep mud is very suggestive. The posterior foot is bent on the leg, and the antero-posterior strain of the weight or propulsive force, is transverse to its long axis. In progression on dry land, the impact is in the direction of the length or axis of the foot. The obvious effect of a cross strain is to produce by degrees greater and greater mobility of some articulation. The one which has yielded is that between the two tarsal rows. Another effect of walking in swampy ground is to spread the digits apart. As the first digit of both feet is always of reduced size, there are practically but four digits to be considered. The weight falling nearly medially on these, would tend to spread them equally, two on each side. Thus the same cause may have been effective in producing both the artiodactyle structures. The perissodactyle structure, so soon as the lateral digits are much reduced, ceases to be favorable for progression in soft ground, owing to the liability of the lateral digits to injury, in following the principal one into the yielding material, filled with sticks and other hard débris.

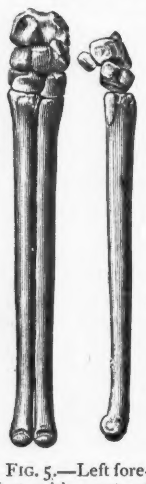

FIG. 5.—Left fore-foot with part of radius of *Poëbrotherium vilsoni* Leidy, from Colorado, three-fifths nat size. From Hayden's Report, IV, Pl. CXV.

The lowest existing forms of the *Artiodactyla*, the *Omnivora*, are universally swamp lovers and livers. So we are told are the lower existing *Perissodactyla*, the tapirs and rhinoceroses. The higher types of both orders are dwellers on plains and in forests. We do not know the habits of the Eocene *Perissodactyla*, but I doubt their having inhabited muddy ground to the same extent as

the hogs and hippopotami, the lowest of the *Artiodactyla*. Now in progression on dry land, any preëxistent inequality in the length of the digits would tend to become exaggerated. Such an inequality exists in the *Amblypoda*, the third digit being a little the longer. In rapid movement on hard ground the longest toe receives the greatest part of the impact, even if its excess of length is but little. The harder the ground the larger the proportion of impact it will receive.

The fact that the *Perissodactyla* did not develop the solidungulate or equine foot, until a late geological period, or in other words, that the orders so long retained the digital formula 4—3, would indicate that it did not adopt a habitat which required great speed as a condition of safety, so early as the *Artiodactyla*.

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PROGRESS OF INVERTEBRATE PALÆONTOLOGY IN THE UNITED STATES FOR THE YEAR 1880.

BY DR. C. A. WHITE.

THE palæontological work of 1880 has been done mainly by the same persons whose works were noticed in the NATURALIST's review for 1879. None have died during the past year, and at least one new worker has appeared in the ranks of American palæontologists. With one important exception the channels for the publication of the results of palæontological work remains the same as last year. Palæontology has suffered a serious loss in the closing of the important channel of publication which was for so many years afforded by the Government Survey under the direction of Dr. Hayden. At present, therefore, no great works of well illustrated invertebrate palæontology are in progress, except those of New York, Ohio and Wisconsin, but more especially that of the first-named State.

Dr. Charles Barrois, of Lille, France, published in the *Revue Scientifique* (Paris), for September, 1880, a review of Volume v, Part II, Palæontology of New York, by Professor James Hall; and a translation of the same was published in the January, 1881, number of the *American Journal of Science*. In that review Dr. Barrois gives, besides a summary of the contents of the volume, some interesting discussion of the relation of the Devonian Gas-

teropoda, Pteropoda and Cephalopoda of the New York rocks with those of Europe.

Dr. J. W. Dawson, in the November, 1880, number of the *American Journal of Science*, published a "Revision of the Land Snails of the Palæozoic Era, with Descriptions of New Species;" pages 403–415, with numerous wood-cuts. In this paper Dr. Dawson describes the following species, the second and last being new forms: *Pupa vetusta* Dawson, with the variety *tenuistriata* Dawson, *Pupa bigsbyi* Dawson, *P. vermillionensis* Bradley, *Zonites (Conulus) priscus* Carpenter, *Dawsonella meeki* Bradley, *Strophites grandæva* Dawson. The descriptions are accompanied with interesting discussions of the relations of these shells with living forms.

In the January, 1880, number of the *American Journal of Science*, page 50, Professor W. B. Dwight has given an account of his discoveries of fossils in the Wappinger valley, or Barnegat limestone of Duchess county, N. Y., which is a continuation of the subject as treated by him in the May, 1879, number of the same journal. In this article he has enumerated many well-known forms belonging to the Trenton and Calciferous epochs, and proposed the name *Discina conica* for a new form which he refers to the age of the Trenton limestone; and which, in the June, 1880, number of the *Journal*, he describes and figures under the name of *Orbiculoidea conica*. Professor Dwight has also a brief article on the same subject in the January, 1881, number of the same journal, in which he claims for the lower series of those rocks the existence of "a wealth of Cephalopodic life of a character and abundance hitherto unknown in the United States in any formation to which it is likely to belong, *i. e.*, below the Trenton and Black River strata." He proposes to publish full details of his discoveries, with further results.

Mr. S. W. Ford has a note in the February, 1880, number of the *American Journal of Science*, on the *Atops trilineatus* of Emmons, in which he claims that the species figured by Emmons in his Taconic System, p. 20, and in the Agricultural Report of New York, Vol. I, p. 64, is not *Triarthrus beckii*, as supposed by Hall and Walcott, but that it belongs to the genus Conocoryphe.

Professor James Hall is still prosecuting his great work on the Palæontology of New York. Part II, of Vol. V, has been issued since my summary of last year's palæontological work was writ-

ten, and Dr. Barrois' review of the same has already been noticed.

It is expected that Part I, of Vol. V, will soon be issued, and Vol. VI is also well in progress, thirty-nine of the plates being already engraved. During the past year Professor Hall has published, under the title "Corals and Bryozoans of the Lower Helderberg group," a pamphlet of thirty-eight pages, referring to twenty-two of the plates of Vol. VI, which volume is to be especially rich in those forms. He informs me that he has in preparation a supplement to Vol. V, Part II, for which there are already sixteen plates engraved. He also published, in the December, 1880, number of *Science*, a "Note on the relations of the Oneonta and Montrose sandstones of Vanuxem, and their relation to the sandstones of the Catskill mountains," which, although mainly geological, is still of considerable palæontological interest. Professor Hall states that the Oneonta sandstone is not a part of the Chemung group, as has been supposed, but that it constitutes a separate series of strata, the true position of which is between the Hamilton and Chemung groups, and expresses the opinion that those strata were deposited under "estuary and fresh-water conditions." He regards those shells which characterize these strata, and which were described by Vanuxem as *Cypricardites cattskillensis* and *C. angusta* as belonging to the genus Anodonta.

Professor A. Hyatt has nearly completed his illustrated memoir on the Ammonites of the Lower Lias, which is to be published by the Museum of Comparative Zoölogy at Cambridge, Mass.

Dr. G. Hambach has an interesting "Contribution to the Anatomy of the Genus Pentremites, with Description of New Species," in Vol. IV, Transactions St. Louis Academy Science, pp. 145–160, with two lithograph plates. He has in hand a monograph of all the known American and European forms of the Blastoideæ.

The appointment of Mr. Angelo Heilprin as Professor of Invertebrate Palæontology at the Academy of Natural Sciences of Philadelphia is a gratifying indication of progressive spirit in that well-known institution. In Vol. III, of the Proceedings of the U. S. National Museum, is to appear an article from his pen entitled, "On some New Species of Eocene Mollusca from the Southern United States," embracing pages 149–152, and accompanied with one plate of illustrations. He has also prepared an

article for publication in the Proceedings of the Academy "On some new Lower Eocene Mollusca from Clark county, Alabama, with some points as to the stratigraphical position of the beds containing them." Professor Heilprin has also completed the preparation of a "Revision of the Eocene Mollusca of the Eastern and Southern United States," which, when published, will constitute a much needed addition to our palæontological literature.

Mr. S. A. Miller has continued his publications in the Journal of the Cincinnati Society of Natural History during the past year. He began a series of articles, mainly historical, in the October, 1879, number of the Journal, entitled "North American Mesozoic and Cenozoic Geology and Palæontology," which he has continued in each subsequent number to that of January, 1881. He informs me that it will be completed in the next April number, and that the whole series will embrace upwards of three hundred pages. In the January, 1880, number, Mr. Miller has three palæontological articles, entitled respectively, "Silurian Ichnolites, with definitions of new genera and species;" "Descriptions of two new species from the Niagara group and five from the Keokuk group;" and Note upon the habits of some fossil Annelids; the two first mentioned being illustrated. In the first named of these three articles he proposes six new generic names for as many different kinds of tracks which he has found upon the Lower Silurian slaty shales near Cincinnati. The July and October, 1880, number, and the January, 1881, number of the Journal, each contains an illustrated palæontological article from his pen, entitled respectively, "Description of four new species of Silurian fossils;" "Description of four new species and one variety of Silurian fossils;" and "Description of five new species of Silurian fossils, and remarks upon an undetermined form." Mr. Miller has also completed the MS. of catalogue of the North American Mesozoic and Cenozoic fossils, upon the same general plan of his catalogue of Palæozoic fossils published a few years ago, which he hopes soon to publish.

Professor A. S. Packard, Jr., in the July, 1880, number of the AMERICAN NATURALIST, has an instructive illustrated article on "The structure of the eye of Trilobites." In concluding this article Professor Packard says, "I now feel authorized in claiming that the Trilobite's eye was organized on the same plan as that of the Limulus, and thus when we add the close resemblance in the

larval forms, in the general anatomy of the body-segments, and the fact demonstrated by Mr. Walcott that the Trilobites had jointed, round limbs (and probably membranous ones), we are led to believe that the two groups of Merostomata and Trilobites are sub-divisions or orders of one and the same sub-class of Crustacea for which we have previously proposed the term *Palæocarida*." In his memoir on the Anatomy and Embryology of Limulus, he also makes direct structural comparisons of the eyes of Trilobites and Limulus.

Mr. Samuel H. Scudder has published in the Bulletin of the Harvard College Library two installments of his Bibliography of Fossil Insects, and a third installment will soon be out. He has also completed a memoir on the Devonian Insects of New Brunswick for the Boston Society of Natural History, the general conclusions of which have appeared in the form of an article in the *American Journal of Science* for February. Besides these works he has in hand a paper on the geology and palæontology of Florissante, Colorado; and another on the structure and affinities of Euphorberia M. & W.

Advance sheets of two posthumous articles by the late Wm. M. Gabb, edited by Geo. W. Tryon, Jr., have lately been issued by the Acad. Nat. Sci. Philadelphia. They are entitled respectively, "Descriptions of Caribbean Miocene Fossils," and "Descriptions of New Species of Fossils from the Pliocene clay beds between Limon and Moen, Costa Rica, together with notes on previously known species from there and elsewhere in the Caribbean area." They comprise together pp. 337–380, and plates 44–47, inclusive, of the Jour. Acad. Nat. Sci. Philad. (2). Vol. VIII. In the latter paper Mr. Gabb has proposed the new generic name of *Parkeria* for a group of gastropods (not *Parkeria* Carpenter and Brady, a genus of Foraminifera).

Lieut. A. W. Vogdes published in the Proc. Acad. Nat. Sci. Philad. for 1880, p. 176, "Description of a new Crustacean, *Calymene rostrata*, from the Upper Silurian of Georgia, with remarks upon *Calymene clintoni*." Four wood-cuts.

Messrs. Wachsmuth and Springer have in press the second part of their Revision of the Palæocrinoidea, and also a supplement to the first part. It is the intention of the authors to complete this important work as soon as practicable.

Mr. C. D. Walcott has been long absent upon distant field

duties, but he is known to have, in an advanced state of progress, some important investigations concerning the structure of Trilobites.

Professor A. G. Wetherby has continued his publications in the Jour. Cin. Soc. Nat. Hist. during the past year. In the January, 1880, number, he has an illustrated article entitled, "Descriptions of new Crinoids from the Cincinnati group of the Lower Silurian and the Subcarboniferous of Kentucky." Also in the July, 1880, number, "Remarks on the Trenton limestone of Kentucky, with descriptions of new Fossils from that formation and the Kaskaskia (Chester) group, Subcarboniferous;" likewise illustrated. In the last-named article Professor Wetherby proposes the new genus *Hybocystites.* The January, 1881, number of the same journal contains another illustrated article from his pen, entitled "Description of Crinoids from the Upper Carboniferous of Pulaski county, Kentucky." Besides these published articles, Professor Wetherby has two or three others in a forward state of progress.

In the June, 1880, number of the *American Journal of Science,* Professor R. P. Whitfield has an article "On the occurrence of true Lingula in the Trenton limestones," illustrated by two woodcuts. His remarks are based upon a new species from Minnesota, which he calls *L. elderi.* In the Annual Report of the Wisconsin Geological Survey for 1880, pp. 44–71, he has published "Descriptions of new species of Fossils from the Paleozoic formations of Wisconsin." He herein proposes a new generic designation for a group of corals which he states to be in all respects compound Cystophyllia, under the name of *Cystostylus.*

Professor H. S. Williams has an interesting article in the December, 1880, number of the *American Journal of Science,* entitled "Abstract of some palæontological studies of the Life History of *Spirifer lævis* Hall," upon a subject which may be properly designated synthetic palæontology. In this article Professor Williams traces a series of forms of Spirifer, which are known in different formations by different specific names, through the strata of all the formations, from the Niagara to the Chemung, inclusive, and says of these groups of shells: "There is nothing of a specific character evolved in this series of forms which did not appear in the first forms; but there is every evidence for the belief that the species has lived through this long geological time without losing its character, and that all

that has resulted from great time and change of conditions has been the fixing into race-groups of the original variable characters of the species."

Professor N. H. Winchell, in his Eighth Annual Report of the Geological and Natural History Survey of Minnesota for 1880, describes ten species of brachiopods from the Trenton and Hudson River formations of that State.

The following articles and notes have been published during the year 1880 by the writer of this article: "Descriptions of new species of Carboniferous Invertebrate Fossils" (illustrated); "Note on *Endothyra ornata*;" "Note on Criocardium and Ethmocardium;" "Descriptions of new Invertebrate Fossils from Kansas and Texas" (illustrated); all in Vol. II Proceedings of the U. S. National Museum. In the first of these the genus *Lecythiocrinus* (not *Lecythocrinus* Müller nor Zittel) is proposed, and in the second the sub-genus *Ethmocardium*. Also in Vol. III of Proc. U. S. National Museum, "Note on the occurrence of *Productus giganteus* in California" (illustrated); "Note on Acrothele;" "Description of a new Cretaceous Pinna from New Mexico;" "Note on *Stricklandinia salteri* and *S. davidsoni* in Georgia;" "Description of a very large fossil Gasteropod from the State of Puebla, Mexico" (illustrated); "Descriptions of new Invertebrate Fossils from the Mesozoic rocks of Arkansas, Wyoming, Colorado and Utah." In the July, 1880, number of the *American Journal of Science*, he has an article "On the Antiquity of certain subordinate types of fresh-water and land Mollusca," in which it is shown that numerous types which characterize the living molluscan fauna of North America, had their origin at least as early as the earliest Eocene and later Cretaceous epochs.

The Contributions to Invertebrate Palæontology, Nos. 2–8, which in the NATURALIST'S summary for 1879, were announced as in press, have been published as a single extract from the Twelfth Annual Report of the U. S. Geol. Survey of the Territories, and embrace, besides 171 pages of text, thirty-two plates instead of twenty-eight, as then announced.

Besides the foregoing, which are already published, the writer of this article has in press a brief palæontological report to Capt. Geo. M. Wheeler, on some Carboniferous fossils from Northern New Mexico, with two quarto plates of illustrations; and also a report to Professor John Collett, State Geologist of Indiana, accompanied by eleven octavo plates of illustrations.

EVIDENCES OF THE EFFECT OF CHEMICO-PHYSICAL INFLUENCES IN THE EVOLUTION OF BRANCHIOPOD CRUSTACEANS.

BY CARL F. GISSLER, PH.D.

DURING the winter months *Eubranchipus vernalis* Verrill,[1] occurs near Maspeth, L. I., in immense numbers, in large communicating ponds containing clear, yellowish, fresh water. In January 1880 I found in a small and entirely isolated pool, less than a hundred paces from the above-mentioned place, a number of perfectly colorless, smaller, but sexually mature individuals of these branchiopod Crustaceans. The bottom of the pool is a white and very soft clay, and the water itself is of a milky color. I collected a number and observed the following differences:

A. Very few individuals of both sexes bearing, with the exception of the transparent body and the red furca of the post-abdomen, the same characters as Eubranchipus.

B. A great number of colorless individuals from fifteen to twenty-two mm. in length. These differ from the larger, red Eubranchipus, in the following particulars. Cephalic scute large and convex; basal joint of male clasper cylindrical; claspers crossing each other, short, tip of second joint with a blunt minute tooth; second joint more or less conical, tapering. A more full account I will soon give in Professor A. S. Packard's monograph on Phyllopod Crustaceans of the sexual organs, copulation and the biology of these colorless individuals.

C. A single specimen of male Chirocephalus.

D. A hermaphrodite. Sexual organs separate, both male and female claspers present.[2]

E. A single male individual with a minute tooth on the second joint of its right clasper; tooth wanting on the left. Left clasper in normal position, right clasper twisted around, thus apparently preventing the animal from using it in copulation. The tooth is probably a substitute for the distorted hook, and assumes its func-

[1] "Observations on phyllopod Crustacea of the family of Branchipidæ, with descriptions of some new genera and species." By A. E. Verrill, professor of zoölogy. 1869.

[2] I described this hermaphroditic form in AMERICAN NATURALIST, February, 1881, pages 136 to 139.

tion. This exemplifies Dr. Dohrn's theory[1] of the consecutiveness of functions whose bearings concern one and the same organ, brought about by evolution. I refer to papers by Professor Cope in the AMERICAN NATURALIST, " A review of the modern doctrine of evolution," etc.

Professor Moritz Wagner's migration theory,[2] as well as Dr. Charles Darwin's selection theory,[3] may be employed to explain the occurrence of the above-mentioned sets *A*, *B*, and probably also *C*.

First I must mention that, on keeping a number of Eubranchipus, male and female (the latter with ovaries filled and oviducts empty), together with a number of sets *A* and *B*, males and females (female in the same condition), during five days, I could never observe a single case of crossing; on the contrary, the two (red and white) avoided each other and only copulated among themselves. Now, as to set *A*, I consider them to be the first generation of Eubranchipus, brought along with mud into the little clay pool, by water birds, from the neighboring larger ponds.[4] The transparency of their bodies was produced by the chemico-physical influence[5] of the little clay pool, and not by " mimicry." As the pool is an isolated one, there was no chance for the absorbing or obliterating influences of crossing with the original red Eubranchipus; consequently the offspring of this new, colorless race, influenced by different factors, were liable to submit to still further evolutionary transformations which I believe have been realized in set *B*: The animal gradually degenerated into a much smaller one with the above-mentioned characters. The factor that produced it was a conservative one, favoring the preservation of

[1] " Der Ursprung der Wirbelthiere und das Princip des Functionswechsels." Genealogische Skizzen von Dr. Anton Dohrn. 1875.

[2] " Die Darwin'sche Theorie und das Migrationsgesetz der Organismen." Von Dr. Moritz Wagner. 1868. The refutation of Wagner's law of migration was attempted by my former tutor, Professor Dr. Aug. Weismann (" Ueber den Einfluss der Isolirung auf die Artbildung," 1872); owing to a misconception of Wagner's paper he combined his theory with Darwin's selection theory, whilst both theories considerably deviate from each other as regards the compelling mechanical cause. See also *Kosmos*, IV, April, 1880 : " Ueber die Entstehung der Arten durch Absonderung." Von Moritz Wagner.

[3] " On the Origin of Species by Means of Natural Selection." 1859.

[4] J. A. Ryder in AMER. NAT., XII, page 703.

[5] See also papers by W. J. Schmankewitsch in *Zeit. für wiss. Zool.*, 1872, 1875 and 1877.

this new species.[1] The factor that produced the individual *E* was a compelling mechanical cause originating in a pathological condition. According to Dr. Darwin, the mechanical cause enters into activity with the appearance of "favorably varying" individuals whose morphological deviations are either inherited or adapted. As to *C*, the genus Chirocephalus, I have reason to suspect in the lobed and prolonged frontal tentacles only a product caused by either chemico-physical or a sudden change in climatological influences. The successive appearance of Chirocephalus and Streptocephalus in one and the same pond near Woodbury, N. J.,[2] rather strengthens my assumption.[3]

The hermaphroditic form *D* shows characters closely relating it to set *A*. From the study of comparative anatomy it follows that hermaphroditism, *i. e.*, the coëxistence of both male and female sexual organs in one individual, is the primitive condition of sexual differentiation, which may in time be followed by a complete separation of the sexes.[4] Hermaphroditism and parthenogenesis can be regarded as cases of atavism—as a reoccurrence of former, primitive conditions. Further progress in differentiation of the sexual conditions, Haeckel ascribes to "division of labor" (Arbeitstheilung). The bilateralism in this hermaphrodite indicates close relationship and coördination between the sexual organs and auxilliary copulation organs. According to Dr. Chas. S. Minot's theory,[5] it is possible that a male genoblast was formed by the splitting of a neutral cell on one side, and a female genoblast in the same manner on the other side of the post-abdomen at an early larval stage, and that then, as the animal became gradually more developed, the second pair of antennæ (not hitherto sexually distinguishable) transformed themselves symmetrically in accordance with the bilateral position of the genital glands and their exits. Unfortunately we are absolutely ignorant of the conditions which cause an animal, when capable of making genoblasts, to produce either male, female or hermaphrodite.

[1] Professor Huxley's "The Crayfish:" "In a strictly morphological sense, a *species* is simply an assemblage of individuals which agree with one another and differ from the rest of the living world in the sum of their morphological characters."

[2] J. A. Ryder, *op citat.*

[3] It is not impossible that branchiopod Crustaceans are liable to produce seasonal dimorphic individuals, a parallel to cases observed in Lepidoptera, according to Professor Sam. H. Scudder, Professor A. Weismann and others.

[4] Professor Ernst Haeckel's "Anthropogenie," pages 395, 681, etc.

[5] AMER. NAT., XIV, Feb., 1880.

NOTES ON A FEW OF THE DISEASES AND INJURIES IN BIRDS.

BY R. W. SHUFELDT, M.D., U. S. A.

IT is merely the object of this brief essay to call attention to the fact that has on so many occasions been so vividly presented to me, during the course of my dissections of bodies of birds and the preparation of their skeletons, of really how comparatively few of them there are that can boast of being perfectly free and exempt from *any* form of disease or the sequelæ of disease; and not to make any attempt to classify or write any extended description of those diseases and injuries to which birds are subject. One among the first cases that was brought to my notice occurred some fifteen years ago, while on a collecting tour in the State of Connecticut, at a period before I could lay barely any claim to the knowledge of disease or make any use of what I observed. In passing through the woods on that occasion I picked up from the ground a nearly full grown female *Molothrus pecoris*, that could barely hop along and was totally unable to fly. She was extremely emaciated and ill-nourished. My curiosity as to the cause of her disability was soon satisfied when I began to part the feathers to search for some injury that perhaps she had sustained. My first anticipations were quickly dispelled, for instead of any injury, I discovered the integument in various localities, particularly the wings and breast, raised up in rather a tent-like manner, in some eighteen or twenty places. Each of these little pockets was occupied by a yellowish-white larva as large as an ordinary white garden bean. These I easily removed, one by one, with a piece of straw, and carried my bird, apparently now much relieved, to the nearest water, some little distance, where she drank as if she had never beheld that fluid before. My surprise now was not very great when, upon releasing her, I found that she could fly some little distance, and undoubtedly subsequently entirely recovered. As I have never seen a similar case, I am to this day ignorant of the habits or even the name of the parasite.

Another remarkable, although common, case of parasitism occurs in Spheotyto, our burrowing owl of the plains. The best example of this I saw in one of these birds two or three years ago. This specimen, too, I could actually pick up from the en-

trance of the prairie-dog burrow, where he sat, scarcely caring, apparently, whether he lived or died. Upon removing, when in my study, the skin of this owl, I was not a little astonished to find many of the organs absolutely displaced by "wads" as large, in some instances, as an almond, of a long hair-like worm, of a pale yellow color, the longest being about 6 c.c. in length. Collections of them in the orbits forced the eyes outwards in this case, and a large roll of them occupied the upper third of the tracheo-œsophageal interspace, completely wedging the two tubes apart.

Subsequently when the skinless cadaver was thrown aside upon my table, these parasites reared for half their lengths and waved to and fro, lending to the body an appearance as if some kind of a pale colored moss was growing from it.

Exostoses not unfrequently occur, either on the shafts of some of the long bones, or upon the surfaces of the flat ones. I have before me a very pretty specimen where one of these bony outgrowths occupies the angle of the carina in the sternum of a specimen of *Eremophila alpestris.* It is nearly as large as a pea, and has a lobulated appearance, jutting forwards.

Aneurismal tumors are sometimes to be seen; the sacs have the appearance of having existed for some space of time—in a few instances.

Muscular atrophy, as far as my observations go, is of rather rare occurrence, although I have seen one good example in the muscles of the lower extremities of a specimen of *Sturnella magna.* There was no apparent cause for it upon *post mortem.* The bird was very loath to take wing, and was killed on the ground, where his locomotion seemed good.

The results of injuries and gun-shot wounds present many examples of interest, and objects for study, if anything, still more engaging. A few days ago I secured a female specimen of *Circus cyaneus* var. *hudsonius,* the horny integuments of whose feet were the sites of many warty excrescences, having the color and general appearances of the parts they occupied. These bodies ranged in size from a duck shot to a small hazel nut. My diagnosis was materially assisted in this case by finding a cactus thorn protruding a little beyond the surface of one or two of the warts, and this foreign body formed the nucleus of all of them.

They were undoubtedly driven forcibly into the feet of this

bird, when it seized small mammals among the cactus beds, where they usually burrow for protection. One of the best unions, after gun-shot fracture, I ever had the pleasure of examining (the specimen is now in the Army Medical Museum), occurred, in the upper third of the humerus, in a specimen of *Mergus serrator*, that I secured several months ago. Taking into consideration the fact that this bird is a vigorous diver, and one of no mean powers of flight, the result, if we may so call it, was an excellent one—there being scarcely any deformity—and the member was as serviceable as ever.

I have seen and possess specimens of many other interesting cases, but their description would extend this paper far beyond the limits. The best examples, and those perhaps worthy at least of a mention, consist of a case of non-union in the palatines of *Anas boschas*, a depressed fracture in the cranium of *Corvus americanus*, gunshot injuries resulting in recovery of the brain in Spheotyto and others.

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THE BRAIN OF THE LOCUST.[1]

BY A. S. PACKARD, JR.

IN order to appreciate the habits, migratory, reproductive, &c., of the locust, and to learn something of its general intelligence as an insect and as compared with other insects, it is necessary for us to study with a good deal of care, the organ of the locust's *mind*, *i. e.*, its nervous system, comprising its nervous centers and the nerves arising from them.

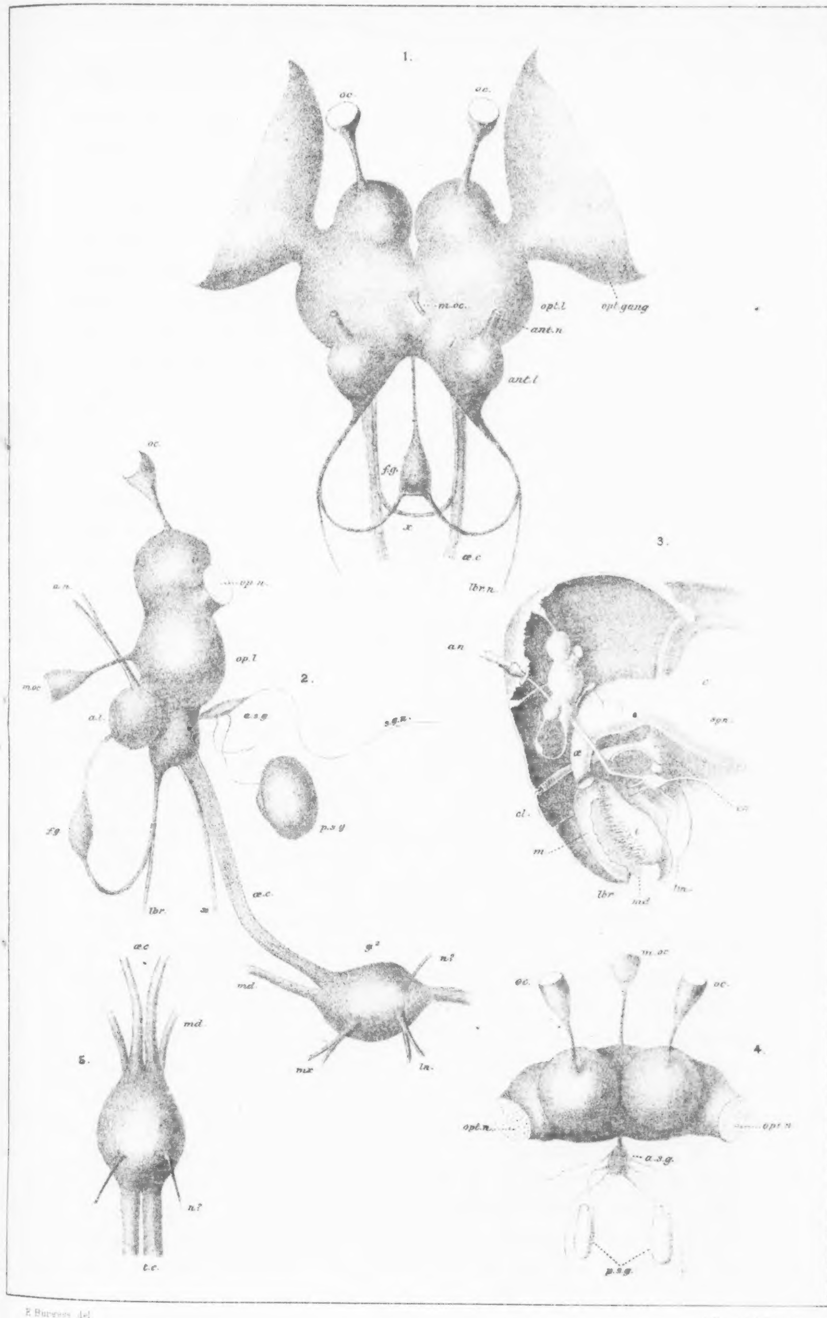
The Nervous System in General.—The nervous system of the locust consists of a series of nerve centers or *ganglia*, connected by nervous cords called *commissures*. There are ten of these ganglia in the locust, *i. e.*, two in the head, the first and largest of which is called the "*brain*;" three ganglia in the thorax, and five in the hind-body or abdomen. The brain is situated in the upper part of the head, resting upon the gullet or œsophagus, whence its true name *supraœsophageal ganglion*. (Plate 1, Fig. 1.) The succeeding nerve-center is situated in the lower part of the head,

[1] Adapted for the NATURALIST from the Second Report of the U. S. Entomological Commission, 1880. We are indebted to the Commission for permission to have an edition of five plates struck off from the lithographic stones at the expense of the publishers.

behind the mouth and under the œsophagus, hence it is called the *subœsophageal ganglion.* (Plate 1, Fig. 5.) The brain really is a double ganglion, being composed of two hemispheres, each hemisphere being a single ganglion or nerve-center; all the succeeding ganglia are also double ganglia; but for convenience we will call the "brain," and each of the succeeding nerve-centers a *ganglion.* Each side of the brain contracts, and then swells out into a rounded portion next to the eye, called the *optic ganglion.* (Pl. 1, Fig. 1.) From this optic ganglion the optic fibers proceed to the facets of the eye. The optic ganglion connects with the brain by the large optic nerve. There are, then, two *optic nerves*, besides three slender nerves *(ocellar nerves)* sent to each of the three *ocelli* or simple eyes; moreover, a nerve is sent to each of the antennæ, and are hence called the *antennal* nerves. The relations of the brain to the head, and to the succeeding ganglion, and the origins of the nerves distributed to the eyes, antennæ and ocelli, as well as of the nerves sent to the jaws, etc., are clearly seen in the figures on Plate 1.

On the other hand the mouth parts, *i. e.*, the jaws *(mandibles)* and accessory jaws (first and second *maxillæ*, the latter called the *labium* or under lip) are each supplied by a pair of nerves, called respectively the *mandibular*, *maxillary* and *labial* nerves. These three pairs of nerves arise from the subœsophageal ganglion. (See Pl. 1, Fig. 2, g^2.)

The Brain of Insects as distinguished from the Brain of Vertebrates.—The "brain," or supraœsophageal ganglion is, as we shall see, a much more complicated organ than any of the succeeding ganglia, having important parts which are wanting in all the others, hence it is *par excellence* nearer to our idea of a brain than any of the other nervous centers. It should be remembered, however, that the word, "brain" is applied to this compound ganglion simply by courtesy and as a matter of convenience, as it does not correspond to the brain of a vertebrate animal, the brain of the horse or man being composed of several distinct pairs of ganglia. Moreover, the brain and nervous cord of the fish or man are fundamentally different, or not homologous with those of the lower or invertebrate animals, though the nervous system of the insects and Crustacea present greater analogies to that of the vertebrates than any other of the lower animals, with the exception, perhaps, of the cuttlefish. The nervous cord of



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THE BRAIN OF THE LOCUST.

the insect consists of a chain of ganglia connected by nerves or commissures, while the spinal cord of the fish or man is essentially "a double and fused series of nerve-centers." Moreover, if the vertebrate cord is cut through, a section shows that it consists of two kinds of substances or tissues, called the "gray" and "white" substance. The gray matter is situated in the center, and consists largely of nerve or so-called "ganglion cells," while the external white matter of the brain or cord is composed of a mass of nerve fibers. Now, in the nervous system of insects there is nothing to compare with these substances, but the ganglia, on the contrary, as we shall see farther on, consist primarily of an external layer of ganglion cells, whose fibers pass in to form a central fibrous mass or net-work, the meshes of which are filled with a fine granulated nerve substance, the nature of which is not clearly understood. Moreover, the entire brain of an insect is white, as are all the ganglia.

A ganglion in its simplest form is a little rounded mass, or nodule, of ganglion cells, with fibers leading from them: such cells are represented by Fig. 3*a*—3*e*, on Plate III. Now when the fibers lead in from the sensitive hairs on the crest of the insect, or from the antennæ, or the eyes or ears, and end in separate masses or lobes, which are modified ganglia, such ganglia are regarded as "sensory ganglia," and the nerves leading in from them are called ingoing or "afferent nerves," while the ganglia which give rise to the outgoing or "efferent" nerves, *i. e.*, those going to the muscles of the wings, legs, &c., are called "motor ganglia."

It should be borne in mind as the result of recent studies by several observers, as Leydig, Flögel, Dietl and Newton, that the subœsophageal ganglion, or "brain," of the insect is much more complex than any other ganglion, consisting more exclusively both of sensory as well as motor ganglia and their nerves. But it should also be understood that the subœsophageal ganglion also receives nerves of special sense, situated possibly on the palpi, and possibly on the tongue, at least the latter is the case with the bee; hence, this ganglion is probably complex, consisting of sensory and motor ganglia. The third thoracic ganglion is also, without doubt, a complex one, as in the locusts the auditory nerves pass into it from the ears, which are situated at the base of the abdomen. But in the green grasshoppers, such as the katydids and their

allies, whose ears are situated in their fore legs, the first thoracic ganglion is a complex one. In the cockroach and in the *Leptis* (Chrysopila), a common fly, the caudal appendages bear what are probably olfactory organs, and as these parts are undoubtedly supplied from the last abdominal ganglion, this is probably composed of sensory and motor ganglia; so that we have in the ganglionated cord of insects a series of brains, as it were, running from head to tail, and thus in a still stronger sense than in vertebrates the entire nervous system, and not the brain alone, is the organ of the *mind*, or psychological endowments, of the insect.

We will now proceed to examine the brain of the adult *Caloptenus spretus*, and compare it with that of other insects; then study its development in the embryo, and finally examine the changes it undergoes in the larva and pupal stages before attaining the fully developed structure of the adult locust.

Histological Elements of the Brain.—The brain is histologically or structurally divided into two kinds of tissue or cellular elements.

1. An outer, slightly darker, usually pale-grayish white portion is made up of "cortical cells," or "ganglion cells." (Pl. III., Fig. 3, *a, b, c, d.)*

This outer loose cellular envelope of the brain consists of large and small ganglion cells. Where the tissue consists of small ganglion cells, it is naturally from the denser arrangement of the smaller cells, which are packed closer together, rather darker than in those regions where the tissue consists of the more loosely disposed, large ganglion cells.

A. The large ganglion cells (Pl. III., Fig. 3, 3 *a*, 3 *b*, 3 *c*, 3 *d, e)* are oval, and send off usually a single nerve fiber; they have a thin fibrous cell wall, and the contents are finely granular. The nucleus is very large, often one-half the diameter of the entire cell, and is composed of large round refractive granules, usually concealing the nucleolus (the granules are much larger and fewer in number and the nucleolus is less distinct than in the brain of Limulus, the king crab). These large ganglion cells are most abundant and largest on each side of the upper furrow, and in front of the "central body," also at the bottom of the lower furrow, and along the exterior of the optic and antennal lobes, and along the commissural lobes.

B. The small ganglion cells apparently differ chiefly in size from the large ones, and are most numerous in the front swelling of each hemisphere; they surround and fill the calices of the mushroom bodies, and they extend along each optic nerve and form a large proportion of each optic ganglion, especially the layer next to the retina of the eye, though they are replaced by large ganglion cells at the junction of the fibrous part of the optic nerve with the dilated granular portion. The brain is surrounded more or less completely by the connective tissue cells belonging to the mesoderm or middle germ layer, and which are sometimes liable to be confounded with the ganglion cells, as they stain the same tint with carmine. It should be borne in mind that the nervous system, ganglia and nerves, originate from the tegumental or exodermal layer.

II. The medullary or inner part of the brain consists of matter which remains white or unstained after the preparation has remained thoroughly exposed to the action of the carmine. It consists of minute granules and interlacing fibers. The latter often forms a fine irregular net-work inclosing masses of finely granulated nerve matter.

In the antennal and commissural lobes is a third kind of matter, in addition to the granular and fibrous substances, which forms irregularly rounded masses, cream-colored in picro-carmine preparations, and which stain dark with osmic acid. This is called by Dietl "*marksubstanz*," and is described by Newton as "a peculiar arrangement of nervous matter, which appears sometimes as fine fibrillæ, with an axial arrangement, sometimes as a very fine net-work of different thicknesses, and sometimes as thin lamellæ, or altogether homogeneous."

It is to be noticed that this central unstained portion contains few, if any, ganglion cells, and it is most probable that the fibers of which it is composed originate from the cortical ganglion cells. At one or two points at Fig. 3, Pl. III, I have seen the fibers passing in from ganglion cells towards the middle of the brain. In the horseshoe crab (Limulus), owing to the simple structure of the brain, it is evident that the optic and ocellar nerves and posterior commissures originate from the large ganglion cells which in this animal are situated in or near the center of the brain. In the last abdominal ganglion also the fibers arising from the peripheral ganglion cells can very plainly be seen passing in towards

the center of the ganglion and mingling with the fibers forming it. Hence, in all probability the fibrous mass of the central part of the brain mostly originates from the peripheral or cortical ganglion cells.

To briefly describe the brain of the locust, it is a modified ganglion, but structurally entirely different from and far more complicated than the other ganglia of the nervous system. It possesses a "central body," and in each hemisphere a "mushroom body," optic lobe, and optic ganglion, and olfactory lobe, with their connecting and commissural nerve fibers, not found in the other ganglia. In the succeeding ganglia the lobes are, in general, motor; the fibers composing the œsophageal commissures, and which arise from the œsophageal commissural lobes, extend not only to the subœsophageal ganglion, but pass along through the succeeding ganglia to the last pair of abdominal nerve centers.[1] Since, then, there is a direct continuity in the fibers forming the two main longitudinal commissures of the nervous cord, and which originate in the brain, it seems to follow that the movements of the body are in large part directed or coördinated by the brain.[2] Still, however, a second brain, so to

[1] We have seen that the two great longitudinal commissures pass directly from the the brain into and then pass backward from the subœsophageal ganglion, but beyond that point we have not traced their course, as it is generally supposed that they extend uninterruptedly to the last abdominal ganglia. This has indeed been shown to be the case by Michels, in his admirable treatise on the nervous system of a beetle (Oryctes) in Siebold and Kölliker's Zeitschrift für wissen. Zoologie, Band 34, Heft. 4, 1880. Michels states that each commissure is formed of three parallel bundles of elementary nerve fibers, which pass continuously from one end of the ventral or nervous cord to the other. "The commissures take their origin neither out of a central punctsubstanz (or marksubstanz), nor from the peripheral ganglion cells of the several ganglia, but are mere continuations of the longitudinal fibers which decrease posteriorly in thickness, and extend anteriorly through the commissures forming the œsophageal ring to the brain."

[2] The following extract from Newton's paper shows, however, that the infra or subœsophageal ganglion, according to Faivre, has the power of coördinating the movements of the body; still it seems to us that the brain may be primarily concerned in the exercise of this power, as the nerves from the subœsophageal ganglion supply only the mouth parts. "The physiological experiments of Faivre, in 1857 (Ann. J. Sci. Nat., Tom. viii. p. 245), upon the brain of Dytiscus in relation to locomotion, are of very considerable interest, showing, as they appear to do, that the power of coördinating the movements of the body is lodged in the infraœsophageal ganglion. And such being the case, both the upper and lower pairs of ganglia ought to be regarded as forming parts of the insect's brain." Quart. Jour. Micr. Sc., 1879, p. 342.

speak, is found in the third thoracic ganglion of the locust, which receives the auditory nerves from the ears situated in the base of the abdomen; or in the first thoracic ganglion of the green grasshoppers (katydids, &c.), whose ears are in their fore legs; while even the last abdominal ganglion in the cockroach and mole cricket is, so to speak, a secondary brain, since it receives sensory nerves from the caudal stylets which are provided with sense organs.

Description of the sections of the Brain.[1]—We will now describe the sections upon which the subsequent account of the brain is founded. The sections, unless otherwise stated, are *frontal*, *i. e.*, cut transversely across the face from before backwards; in cutting thus through the head, twelve sections were made before the front part of the brain was touched, the thirteenth grazing the front of the brain. Section fourteen passed through the anterior part of both *calices*, but did not touch the stalk of the *mushroom body* (these terms will be explained farther on). It passed through the central region of each hemisphere, including the front part of the *trabeculæ* or base of the stalk of the mushroom body. The section passed through the commissural lobes, the lower third being composed of the ganglion cells, but the substance of the commissure itself is filled with the ball-like masses of "marksubstanz." The commissures to the subœsophageal ganglion were not touched, and do not appear in the section, since they arise from the back of the brain.

In section 15 no additional organs are exposed. In section 16 (Pl. II, Fig. 1) the trabeculæ are seen, when magnified 225 diameters, to be composed of ascending fibers, which form the base or origin of the double stalk of the mushroom body.

Section 17 (Pl. II, Fig. 2) is the most important of all the sections, as the entire mushroom body and the central body are cut through, together with the antennal lobes, and the commissural lobes, and also the origin of the optic nerves.

In section 18 (Pl. II, Fig. 4) the double nature of the stalk of the mushroom body is seen; the optic lobes are now well marked, and the razor grazed the back of the commissural lobes, as well as the inner side of the optic ganglion. The section passed behind the trabeculæ and the base of the stalk and through the back of

[1] We are indebted to Mr. Norman N. Mason, of Providence, R. I., for cutting and mounting the sections used in making the observations here recorded.

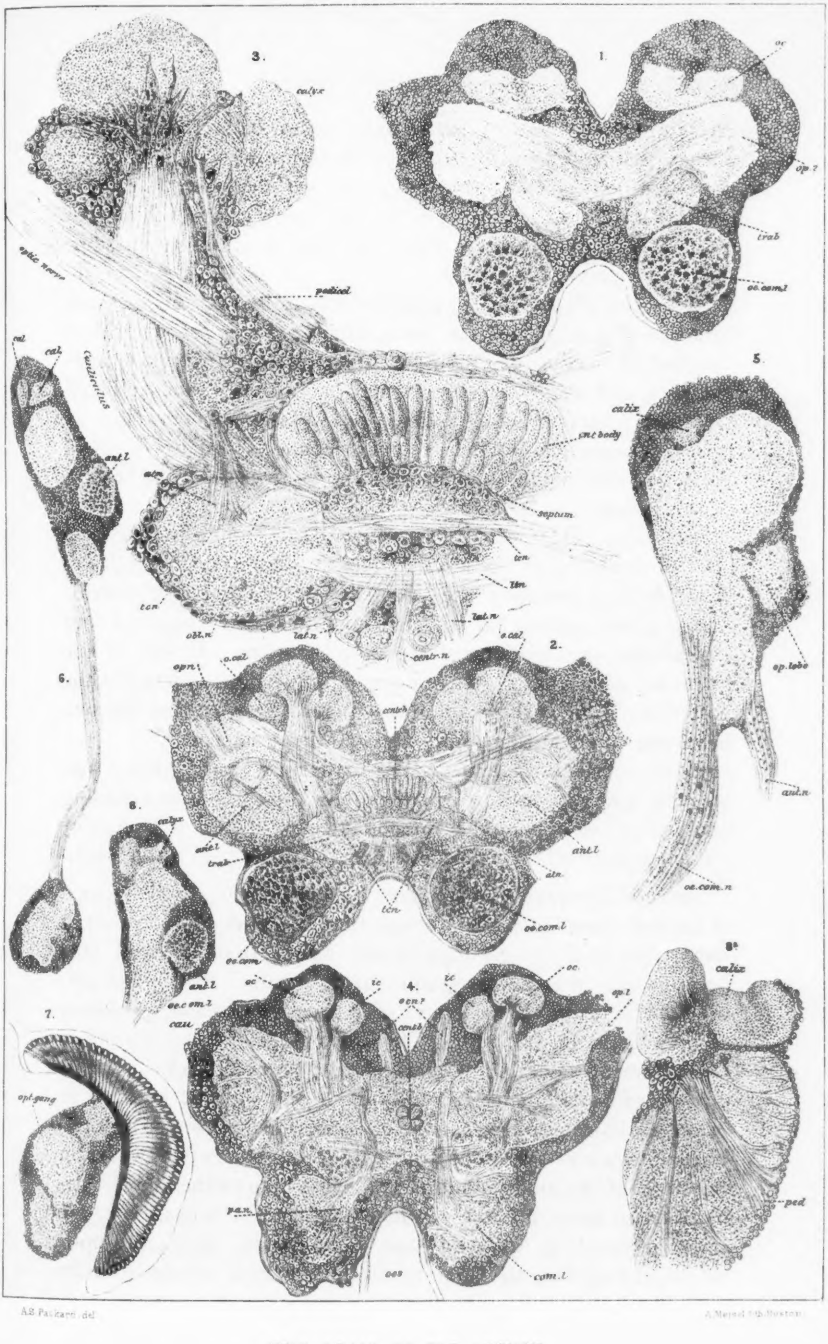
the central body. The calices are each seen to be so furrowed and uneven as to appear in the section as two separate portions. Two important nerves (Pl. II, Fig. 4, *p. a. n.*) are seen to arise from the commissural lobes, and to pass upwards, ending on each side of the upper furrow, near the origin of what we think are possibly the ocellar nerves *(o. c. n. ?).*

Section 19 (Pl. III, Fig. 1) passed through the back of the brain (compare Fig. 4, of the same plate, which represents a vertical or longitudinal section of the brain), through the œsophageal commissures, and the back edge of the calices, while the antennal lobes and a part of the optic lobes are well seen in the section. A transverse commissural nerve *(t c n)* connects the two antennal lobes, and the commissural nerves are seen to cross at the bottom of the furrow.

Section 20 (Pl. III, Fig. 2), which passes through the extreme back of the brain, shows in this plane four transverse bundles of nerve fibers connecting the two hemispheres, *i. e.*, the inferior *(inf. n.)*, two median (m. n.) and a superior nerve *(sup. n.).* In this section the relations of the optic ganglion and eye to the brain are clearly seen, the optic ganglion being situated in the posterior region of the brain. It will also be seen that the two hemispheres are at this point only connected anteriorly.

In sections 22, 23 and 24 the brain nearly disappeared, and only the optic ganglia were cut through by the microtome, affording instructive sections of the three lenticular masses of white unstained granulo-fibrous substance surrounded by ganglion cells.

Internal Topography of the Brain.—Disregarding the envelope of cortical ganglionic cells, though they are evidently of primary importance in the physiology of the insect's brain, we will now describe the internal topography of the brain. It consists primarily of an irregular net-work of nerve-fibers, inclosing masses of granulated nerve matter. This mass is divided into a number of separate areas or lobes, of which the "central body" *(corpus centrale* of Flögel and Newton) is single and situated between or in the median line of the two hemispheres. There is also a primitive superior and inferior central region, better shown, however, in the brain of the embryo and larval locust than in the adult. Besides these areas are the rounded masses or "lobes," *i. e.*, the optic, antennal, or olfactory and commissural lobes; the optic nerves arising from the optic lobes, the antennal nerves from the



A.S. Packard, del. A. Meisel lith. Boston.

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antennal lobes, and the commissures surrounding the œsophagus and connecting the brain with the subœsophageal ganglion, and which arise from the commissural lobes. Finally a "mushroom body" is situated in the upper and central part of each hemisphere.

The Central Body.—This is the only single or unpaired organ in the brain. It is best seen in section 17 (Pl. II, Fig. 2), which also passes through the optic and antennal lobes and the trabeculæ and mushroom bodies. This singular organ is apparently present in all winged insects, though differing somewhat in structure in different insects. It is, as seen in Pl. II, Fig. 2, situated in the same plane as the peduncle and in the same plane as the center of the entire mushroom body, and rests upon the inner sides of the trabeculæ. Section 16 does not pass through it, though the next section, which is $\frac{1}{500}$ inch thick, passes through its middle. Section 18 (Fig. 4) passes through its back, while the next section does not include any part of it; hence its antero-posterior diameter is slightly over $\frac{1}{500}$ of an inch. It is about twice as broad as high, and thus is a small body, though from the universality of its occurrence in winged insects, it may be one of considerable importance.

It is surrounded by a dense net-work of fibers containing a few small ganglionic cells, the fibers in front continuous with those near the bottom of the frontal median furrow and connecting the two optic lobes. Posteriorly the fibers apparently are not continuous with those of the trabeculæ; hence the central body appears to be quite isolated from the rest of the brain. Its substance, when magnified 400 diameters, appears to be a white granular matter like the adjoining parts of the brain. It is divided into two parts, the superior and inferior, the former part constituting the larger part of the body. The inferior portion is separated by fibers from the superior; it contains numerous nucleated spherical cells situated either irregularly or perhaps primarily (see Pl. IV, Fig. 3, of the pupa) in two rows when fewer in number than in the adult. The superior and larger division of the central body contains two series of what we may call *unicellular bodies*, sixteen in a series. The lower series are spherical or slightly elongated, and rest in the fibrous partition or septum, forming the floor of the superior division of the central body. The upper row of bodies are cylindrical, and about three or four times as

long as thick. They are separated by thin fibrous septa. Pl. IV, Fig. 2, represents the central body enlarged 225 diameters. When we examine the central body in an earlier stage, *i. e.*, the second pupal (Pl. IV, Fig. 3), we see that the body is covered above by a stratum of nucleated ganglion cells continuous with those next to the bottom of the upper furrow; and that the fibrous septum between the upper and lower division also contains small cells. These cells disappear in the adult, and evidently give rise to the fibers which take their place. It will also be seen that the "unicellular bodies" are shorter, more cell-like than in the adult; hence they seem to be modified ganglion cells, which have at an early date lost their nucleus and nucleolus. My observations on the central body of the locust agree in the main with those of Newton (compare his Fig. 9). His drawings are not especially clear and definite, but the differences appear to be unimportant. There are perhaps two (16 instead of "12 or 14") more cellular bodies in the locust than in the cockroach. Unfortunately my sections of the brain of the cockroach do not show the central body. Dietl states that the central body is a "median commissural system." This description we would accept in a modified sense. We have shown that the unicellular bodies and the cells beneath them were once like the ganglion cells, but that they have lost their nuclei and nucleoli; hence the functions of the central body must be unlike that of an ordinary commissural lobe. Flögel states that the number of "sections," or what I call unicellular bodies, is eight; we have counted sixteen. Both Flögel and Newton appear to regard these bodies as simply spaces or sections between fibrous partitions; but it would appear that these sections are really modified cells, and that the fibrous septa are possibly the cell-walls, somewhat modified.

The Mushroom Bodies.—These curious organs have attracted a good deal of attention from writers on the brain of insects. Dujardin, in 1850, first drew attention to them. His memoir we have not at hand to refer to, but as stated by Newton[1]—

"Dujardin pointed out that in some insects there were to be seen upon the upper part of the brain certain convoluted portions which he compared to the convolutions of the mammalian brain, and, inasmuch as they seemed to be more developed in those insects which are remarkable for their intelligence, such as ants,

[1] On the Brain of the Cockroach. By E. T. Newton. Quart. Journ. Microscopical Science, July, 1879, pp. 341, 342.

bees, wasps, &c., he seemed to think the intelligence of insects stood in direct relationship to the development of these bodies. The form of these structures is described by the same author as being, when fully developed, as in the bee, like a pair of disks upon each side, each disk being folded together and bent downwards before and behind, its border being thickened and the inner portion radiated. By very careful dissection he found these bodies to be connected on each side with a short pedicle, which bifurcates below to end in two tubercles. One of these tubercles is directed towards the middle line, and approaches but does not touch the corresponding process of the opposite side. The second tubercle is directed forwards, and is in close relation to the front wall of the head, being only covered by the pia mater (neurilemma). These convoluted bodies and the stalks upon which they are mounted are compared by Dujardin to certain kinds of mushrooms, and this idea has been retained by more recent writers on the subject."

The form of the mushroom body is much more complicated in the bee or ant than in insects of other orders. In the cockroach and in other Orthoptera, notably the locust, the four divisions of the calices are united into two; while the structure of the calyx in the cockroach is quite different from that of the locust. Mr. Newton, is his description, notwithstanding Dujardin's statement, appears to practically limit the term "mushroom body" to the cap or calyx on the end of the stalk. In the following description we apply the term "mushroom body" to the entire structure, including the base or trabecula, the double stalk, and the cap or calyx.

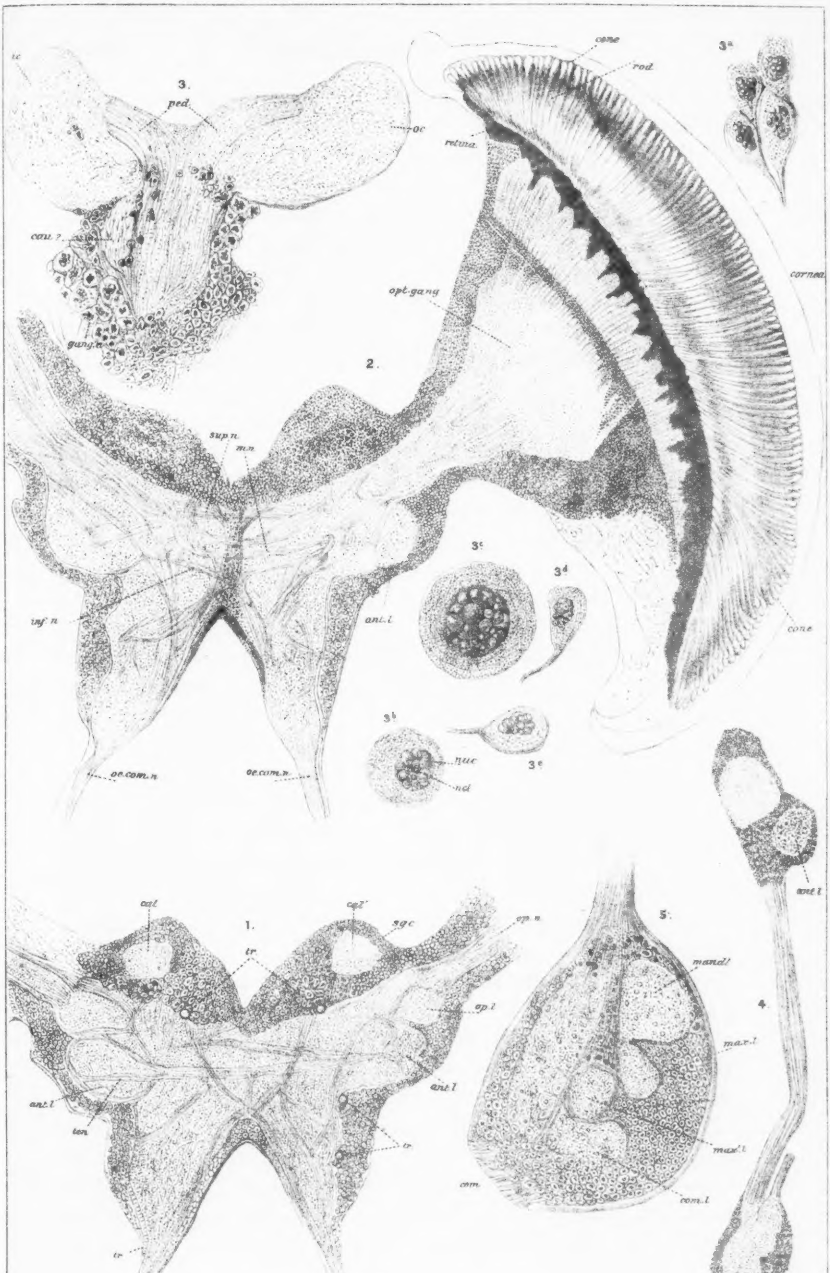
So far as we have been able to observe, the double stalk of the mushroom body rests on a rounded mass of granulo-fibrous nerve matter; this rounded mass or base of the column is called the *trabecula* (Pl. II., Fig. 2, *trab.).* The two trabeculæ (one in each hemisphere) are much more widely separated (in my sections) than in the cockroach or in those insects studied by Flögel; the space between them being filled by a loose cellular mass containing small nucleated cells. The thickness of each trabecula is greater than that of the double stalk. Section 14 passes through the outer or anterior edge of the trabecula, and also through the calices at some distance from the edge. Section 18 (Fig. 4) does not include it, though showing well the mushroom body, with the exception of the base of the double stalk. It follows that the thickness of the trabecula is about $\frac{3}{500}$ of an inch.

The substance of the trabecula is seen to be minutely fibrous

under a power of 725 diameters, with masses of granules among the fibers which are much finer than in the optic or antennal lobes. At the point passed through by section 17 the trabeculæ appear to have no connection with the stalk, but the latter appear to stop abruptly just before reaching it, the envelope of ganglionic cells and fibers surrounding the trabeculæ being interposed between the base of the stalk and the trabecula. (This does not preclude the fact that the stalk does not arise from the trabecula, though there are no signs of it in this section; for it clearly appears to thus arise in the drawings and descriptions of Dietl, Flögel, and Newton.)

The structure of the trabeculæ in the locust, judging from our sections, appears to be more complex than would be inferred from the observations of the other anatomists just mentioned. Section 17 (Pl. II., Fig. 2, *trab.)* passes through the middle of each of these bodies, and it then appears that there are four bundles of nerve-fibers passing out of each body. A bundle of transverse nerve-fibers (Fig. 2, *t. c. n.*, and Fig. 3) passes along under the central body, directly through the middle of the trabeculæ, and anastomoses with the fibrous envelope of each trabecula. In front of this transverse intra-trabecular nerve is a small short ascending bundle of fibers (Fig. 3 *a. t. n.)* which passes next to the pedicel, but does not apparently form a part of it, but anastomoses with the fibers on each side of the central body. Below, the fibers pass downward and outward to apparently connect with the fibrous envelope of the trabecula. Another short bundle passes out from the trabecula obliquely towards the central body and anastomoses with the fibrous envelope of the central body.

Below, but in the same plane, is another transverse bundle of fibers (Fig. 3, *l. t. n.)*, which is slightly curved and on the left side its fibers are distinctly seen to enter the trabecula. This lower intrabecular nerve, as we may call it, connects with three vertical short nerves arising from near the edge of the lower furrow between the hemispheres of the brain. Of these, the central one *(centr. n.)* is in the median line of the brain, and the lateral ones *(lat. n.)* are on each side. There would thus seem to be a direct double nervous communication between the two trabeculæ, and with the fibers surrounding the central body, and hence with the rest of the brain. This seems to be opposed to the statement of Newton that the trabeculæ, and the mushroom bodies in general, have no



THE BRAIN OF THE LOCUST.

nervous connection with the rest of the brain. This section also clearly indicates the origin of the optic nerve, which passes *behind* the stalk of the mushroom body, and also the relation of the fibers of the stalk to the calices, as they appear to penetrate far into the interior of the body of each calyx.

The Double Stalk (cauliculus and *peduncle).*—These names are applied to the larger and smaller divisions of the stalk of the "mushroom body." They are represented in the eighteenth section (Fig. 4) where the outer part of the stalk *(cauliculus)* supports the outer calyx, and the inner slenderer column of fibers supports or ends in the inner division of the calyx. These two bundles of fibers are somewhat curved, but as they do not appear in sections 16 and 19, must be less than $\frac{2}{500}$ of an inch thick. Their fibers are seen to penetrate deeply into the base of the calices, and thus to directly communicate with the fine granular substance of the calices.

The Calices.—The cups of the mushroom bodies in the locust differ decidedly in form from those of the cockroach, and this part of the mushroom body is more variable in form in the different orders of insects than any of the other parts of the brain. It is nearly obsolete, or, as Flögel states, "not more than rudimentary" in hemipterous insects (notably *Syromastes)*, and is less completely developed in many smaller moths, beetles, and flies, as well as Neuroptera *(Æschna)*, according to Flögel, than in the larger moths, in the Orthoptera, and especially in the Hymenoptera, where it is well developed. We have been unable to find it as yet in the brain of myriopods or of the spider. In the locust each body is more or less rounded and rudely saucer-like rather than cup-like, with the rim very thick; the hollow of the cup, if it be hollow, is small in proportion to the thickness of the saucer-like cup. The diameter of a calyx is about $\frac{7}{500}$. The anterior edge reaches to the front edge of each hemisphere of the brain, but does not extend to the back part of the brain. The relations in a vertical, *i. e.*, longitudinal section of the mushroom body to the rest of the brain are seen in Pl. II, Fig. 8 *a*. It thus appears that the double stalk is situated near the center of the brain, and that the cup projects far forward, but posteriorly does not extend behind the antennal lobes or the commissures. In section 18 (Fig. 4) the calices are seen to be double, the outer *(o. cal.)* attached to the cauliculus *(cau.)* and the inner arising from the peduncle.

Fig. 8 *a* gives an idea of two calices and their mode of attachment to the stalk. The peduncle (if we interpret that division of the stalk aright) sub-divides, sending a thick bundle of fibers to each calyx, ending abruptly in the hollow of the calyx. The substance of the calices is finely granular, with some coarse granules, and apparently short scattered irregular fibers. The structure of the calices of the locust appears to be more homogeneous than that of the cockroach, judging by our sections of the latter. Owing to different treatment by reagents the dark masses described by Newton as existing in the cockroach were not so clearly shown in my sections ($\frac{1}{1000}$ inch thick) as in those made by Mr. Newton. The substance of the calices when examined under a power of 725 diameters is much the same both in the cockroach and the locust, the dark bodies not appearing in either. The form of the calices is very different in the cockroach, the calices being truly cup-like, the disk being deeply folded, and the edges of each cup being thin compared with those of the locust.

The Optic Lobes.—As seen in section 19 (Pl. III, Fig. 1 *op. l.*) these bodies are larger than the antennal lobes, and consist of numerous irregular small bundles of fibers besides those composing the optic nerve, the interspaces being filled with fine granular nerve substance. The optic nerve is much larger at the outer edge of the lobe before passing into the optic ganglion, the fibers still being immersed in the finely granular nervous substance.

The Optic Ganglion.—This is situated at the back of the brain, and is a large rounded mass of white fine granular nervous matter, enveloped in very numerous but small ganglion cells, which stain dark red by carmine, the granular matter remaining unstained by the picrocarmine. The granular or white portion is subdivided into three rudely lens-shaped masses (see Pl. V, Fig. 1), the one nearest the eye being much the largest.

The Antennal or Olfactory Lobes.—Section 19. (Pl. III., Fig. 1, *ant. l.*). These are smaller than the optic lobes, though in section 19 they appear larger. They give rise to the antennal nerve, and as the locust carries its ears at the base of the abdomen, the auditory nerves entering the third thoracic ganglion, reasoning by exclusion the antennæ in Orthoptera must be organs of smell, and the lobes and nerves to the antennæ are consequently olfactory. This is the opinion of some recent writers, notably Hauser.[1]

[1] Physiologische und histiologische Untersuchungen über das Geruchsorgan der Insekten. Siebold und Kölliker's Zeitschrift für Wissen. Zoologie, Bd. 34, Heft. 3.

The lobes are, as described by the other observers, filled with ball-like yellowish masses, which stain dark by osmic acid, much as in the commissural lobes. Nerve fibers are seen in section 19 to pass from one antennal lobe to the other in the rear of the central body and of the trabeculæ, while other nerve fibers are seen to pass into the optic lobes and the commissural lobes. This system of intra-lobal nerves demonstrates that there is a nervous intercommunication between these cerebral lobes and the ganglionic chain of the entire body.

The Commissural Lobes.—From these large bodies proceed the two great longitudinal commissural nerves, forming the connecting threads of the nervous cord, and which extend from the brain to the last abdominal ganglion, passing through the intermediate nerve centers. The lobes are filled with ball-like masses, of the same general appearance as in the antennal lobes, but more distinct and numerous.

Comparison of the Brain of the Locust with that of other insects.—Newton rightly regards the cockroach's brain as a generalized form of brain, which may serve as a standard of comparison. The cockroach is geologically one of the oldest of insects; its external and internal structure is on a generalized plan, and the brain conforms to this order of things. Our knowledge of the cockroach's brain is derived from the photographs and account of Flögel, and Newton's excellent descriptions and figures, supplemented by two sets of sections made for us by Mr. Mason, but which unfortunately, are quite defective as regards the trabeculæ and stalk of the mushroom body. The shape of the calices of the cockroach, as already stated, is very different from that of these bodies in the locust, and indeed from any other insect yet examined, the cup being very deep and the sides thin; but the intimate structure seems nearly the same in the two insects.

In the cockroach the antennal and commissural lobes are of much looser texture, with large and numerous ball-like masses *(ballensubstanz)*; these are, when magnified 400 diameters, not only larger, but more distinct from the rest of the nervous matter of the lobe than in the locust. When magnified, as mentioned, the ball-like masses appear to be simple masses of finely granular nervous matter, with darker granules, much like the rest of the granular portions of the brain, but with coarser granular masses than in the substance of the optic lobes. These ball-like masses

are surrounded by a lose net-work of anastomosing nerve fibers continuous with those of the antennal nerve, and with scattered nucleated cells, which become very numerous in the antennal nerve. The nerve fibers are stained reddish by the picrocarmine.

Turning now to other orthopterous insects, Flögel mentions Acrydium, but states that he had no serviceable preparations, and after describing the brain of Forficula, the ear-wig, says: "As I observe in Acrydium, the cells and fibers in this animal are especially large, and these objects invite further investigation." Flögel's photograph and description of the brain of Forficula, a representative of an aberrant family of Orthoptera, and Dietl's beautiful figures and descriptions of the brain of the molecricket *(Gryllotalpa vulgaris)* and the cricket *(Acheta campestris)*, show that the orthopterous brain, judging from these representative forms, is constructed on a common type, the most variable part being the calices of the mushroom body.

From these facts we should judge that, on the whole, the locusts were as highly endowed intellectually as any other insects, with the exception of the ants, bees, or wasps, *i. e.*, the social species; for in these forms the insect brain reaches its highest development, as we might expect from the wonderful instincts and power of reasoning exhibited by these social species; while in a number of insects the brain is less developed than in the locust. It would thus appear that, as in the vertebrates, there are different grades of brain-development, considerable extremes existing in the same sub-class of insects, as for example, in the same sub-class of mammals.

The brain of the bee and ant, as shown by Dujardin and demonstrated by Dietl and Flögel, is constructed on a higher, more complicated type than in the other winged insects, owing to the much greater complexity of the folds of the calices or folded disk-like bodies capping the double stalk of this organ.

[*To be concluded.*]

LETTERING OF THE FIGURES ON PLATES I—V.

centr. b., central body.
trab., trabecula.
cau., cauliculus.
ped., peduncle.
o. cal., outer calyx, or cup.
i. cal., inner calyx.
op. l., optic lobe.
op. n., optic nerve.
ant. l., antennal lobe.
ant. n., antennal nerve.
œ. com. l., œsophageal commissural lobe.
œ. com. n., œsophageal commissural nerve.
œ. c., œsophageal commissural nerve.
lbr. n., nerve to labrum.
l. g. c., large ganglion cells.
s. g. c., small ganglion cells.
opt. gang., optic ganglion.
sg. n., sympathetic nerve.
t. n., transverse nerve.
u. intr. n., upper intratrabecular nerve.
l. intr. n., lower intratrabecular nerve.
ln., nerve to labium.
fg., frontal ganglion.
psg., posterior sympathetic ganglion.
lat. n., lateral nerve.
centr. n., central nerve.
obl. tr. n., oblique trabecular nerve.
a. t. n., ascending trabecular nerve.
m. n., two median commissural nerves.
sup. n., superior commissural nerve.
inf. n., inferior commissural nerve.
tr., trachea.
up. l., upper cerebral lobe of embryo.
low. l., lower cerebral lobe of embryo.
gang. c., ganglion cells.
gran., granules of the central nervous matter.
œs., œsophagus.
int., integument.
o. n., ocellar nerve; *oc.*, ocellus.
n. c., ventral nervous cord.
ncl., nucleolus.
lbr., labrum.
md., mandible.
lm., labium.
cl., clypeus.

EXPLANATION OF PLATE I.

FIG. 1.—Front view of the brain of *Caloptenus femur-rubrum*.

FIG. 2.—Side view of the same.

FIG. 3.—Side view of the head showing the relation of the brain to the mouth (*m*) and œsophagus (*œ*) and walls of the head.

FIG. 4.—The brain as seen from above, and the three ocelli.

FIG. 5.—The subœsophageal ganglion seen from above. Drawn by E. Burgess.

DESCRIPTION OF PLATE II.

FIG. 1.—Frontal section 16, through the front of the brain of adult *Caloptenus spretus*; × ½ inch objective, A. eye-piece.

FIG. 2.—Section 17, showing the central body (*centr. b.*) and mushroom body, optic and antennal lobes, and commissural lobes; × ½ A.

FIG. 3.—Enlarged view of the trabecula and its nerves, of the mushroom body, its calices and stalk, and the origin of the optic nerves; × $\frac{1}{5}$ A., 225 diameters.

FIG. 4.—Section 18, passing through the back of the central body, showing the double nature of the stalk of the mushroom body, and passing through the back of the commissural lobes and behind the trabecula and the base of the stalk; × ½ A. Are *oc. n. ?* the origins of the ocellar nerves?

FIG. 5.—Vertical (longitudinal) section through one of the hemispheres, showing the origin of the commissural and antennal nerves and the optic lobe.

FIG. 6.—Longitudinal section through the brain and subœsophageal ganglion (× 50 diameters), showing the two portions of the calyx, the antennal lobe, and in the subœsophageal ganglion the three lobes giving off respectively the mandibular, maxillary, and labial nerves.

FIG. 7.—Longitudinal section through the optic ganglion and the eye; × 50 diameters.

FIG. 8.—Longitudinal section through the brain, showing the calyx, antennal lobes, and commissural lobes; × 50 diameters.

FIG. 8 *a*.—Enlarged view of Fig. 8 (× ½ B.), showing the relations in a longitudinal section of the calyx to the stalk, although the direct connection of the stalk with the calyx is not seen in this section.

DESCRIPTION OF PLATE III.

FIG. 1.—Section 19 (× ½ A), passing through the back of the brain, showing the posterior edge of the calices and antennal lobes and œsophageal commissural nerves and optic nerve. *tr.*, small tracheæ.

FIG. 2.—Section 20, passing through the back of the brain, showing the relation of the optic nerve to the optic ganglion and eye; the cornea, cones, rods and retina of the eye are shown; × ½ A. *sup. n.*, superior, *m. n.*, median, and *inf. n.*, inferior commissural nerves connecting the hemispheres.

FIG. 3.—Enlarged view of upper part of the stalk and calyx, and the ganglion cells surrounding and filling the latter; × 225 diameters. 3 *a*, *b*, *c*, *d*, different ganglion cells seen from different directions, 3 *c* showing the large nucleus filled with coarse granules, but showing no nucleolus; one, however, is seen in Fig. 3 *b*. *ncl.*; × 725 diameters.

FIG. 4.—Longitudinal section of the brain and subœsophageal ganglion, magnified 50 diameters, showing the relations between the two, and of the origin of the œsophageal commissure from the upper side of each ganglion, *i. e.*, from the back of the brain and the upper side of the subœsophageal ganglion.

FIG. 5.—Enlarged view (× ½ B) of the subœsophageal ganglion of Fig. 6, Pl. x, showing the origin of the commissure to the first thoracic ganglion, and on the under side the three lobes (mandibular, maxillary, and labial), whence the nerves are sent to the mouth-appendages. *mand. l.*, mandibular lobe; *max. l.*, maxillary, and *max. l'.*, 2d maxillary or labial lobe; *com.*, commissure to subœsophageal ganglion.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The day is probably not distant when government aid for the protection of agriculturists against injurious plants and animals will be demanded as urgently as for geological, coast and land surveys. Let us glance briefly at the reasons why such aid becomes imperative. Until within three years no special attention had been given by Congress to these subjects; what little had been done by the botanist and entomologist connected with the Department of Agriculture being, from causes beyond their control, too slight to be worthy of mention. What had been done by the Government was much less than the efforts of several States, notably New York, Missouri and Illinois; these States having

appropriated sums amounting from $15,000 to $30,000 for the investigation of injurious insects, with results of the greatest and most obvious importance.

Until the formation in 1877 of the U. S. Entomological Commission, not a dollar was ever appropriated by the General Government for the investigation by experts of injurious insects, nor for the study of the rust, smut, mildew and other injurious fungi by which millions of dollars are lost to agriculture. About a year after the establishment of the commission, Professor Riley, the chief of the commission, was appointed Entomologist to the Department of Agriculture, and during the short time he held the position, by his personal efforts obtained from Congress a special appropriation of $5000 to place his Division upon a more practical basis, and also another appropriation of $5000 for the investigation of the cotton worm. The readiness with which these appropriations were granted, shows that Congress appreciates capable effort in applied entomology. The first-mentioned appropriation has since been made annually to the Department, while others have also been made for continuing the cotton worm investigation under the direction of the U. S. Entomological Commission. These appropriations were the immediate result of the labors and example of this Commission and not of the Agricultural Department itself.

Under the Interior Department, from small beginnings, a large and growing branch of applied Zoölogy has grown under the care and unremitting toil of Professor Baird. We refer to the Commission of Fish and Fisheries. Ten years ago the depleted fisheries of the Atlantic coast and the local disputes of the fishermen attracted the attention of Congress, and Professor Baird was appointed a Commissioner to investigate the causes. The first appropriation was $5000, we believe; the one last year ungrudgingly voted by Congress was about $140,000 in the aggregate. It is needless to state that the practical results of these investigations have been immediate and many-fold the amounts appropriated, and the benefits conferred on American biology enormous. It should be said that the value of our fisheries by the census of 1870 was only $11,096,522, though the estimate is only approximative and imperfect.

Turning to our geological surveys; within the last twenty-five years sums aggregating several millions of dollars, in some years over $200,000 per annum, have been wisely appropriated by Congress for the surveys of the public domain. Owing to the fostering spirit shown by Government, American geology stands preëminent, and ranks as high as in the governments of Europe; and yet compared with the agricultural products of the country, the mineral products of the United States are inconsiderable. By the census of 1870 the mineral products of this country amounted to $152,598, 994. This amount is only approximative, as it was

impossible to obtain exact returns. But it will be seen that for the interests involved, the Government has been liberal in its appropriations for geological investigations, and it will be the best economy to be still more liberal than in the past.

How much has the General Government expended for our national agriculture, whose products amounted, in 1870, to $2,447,538,658, the returns being in the nature of things far more reliable and exact than in the other departments enumerated? We would answer emphatically that beyond laying out the agricultural grounds and erecting the Department building at Washington, distributing seeds (the larger share of which were of the commonest kinds of flowers and vegetables obtained at bargains of seedsmen), the amounts voted by the Government in this direction have not, in the opinion of agricultural experts, or of others well qualified to judge, been at all commensurate with what ought or should have been voted. We do not deny that considerable good has been accomplished by the Agricultural Department, especially of late, in agricultural chemistry and animal diseases. But absolutely nothing has been accomplished in building up those branches of applied science related to agriculture, in creating trained experts, in the issue of scientific and authoritative reports, bulletins and manuals, in obtaining the coöperation and counsels of experts in different parts of the country, all working together for the benefit of a scientific, or in other words common-sense agriculture.

We would ask if the time is not coming for a practical biological survey of the United States commensurate with the immense interests involved, and on a scale analogous to the geological and coast surveys and the signal bureau? At least cannot a slight beginning be made in this direction?

The average annual loss to the nation from the attacks of injurious plants and insects and other animals, amounts at a moderate calculation to $300,000,000. A large proportion of this loss or waste could, by human means, be saved and added to the national capital. Within a period of four years a few of the Western States suffered a loss of $200,000,000, by the attacks of the Rocky mountain locust. The State of Illinois lost in one year (1864) $73,000,000 by the chinch bug; the annual average loss to the cotton crop is estimated at not less than $15,000,000 or $20,000,000. Such figures and estimates could be multiplied.

With a proper reorganization or enlargement of the Agricultural Department, under the direction of a commissioner of intelligence and scientific attainments, these scientific investigations might be begun and carried on, or if this department is hopelessly fated to go on as in the past, the work might be superintended by the Smithsonian Institution, if not carried on under the Interior Department. However this may be, there is urgent need of intelligent extended botanical and entomological investigations. In

time, appropriations for such work would not be needed: the Government need only to foster such investigations, give them a start, and when the work is well advanced, leave it to State and individual action. We leave to another occasion the needs of an investigation of disease-germs, plant-fungi, in connection with rust, smut and mildew, and of cattle diseases, and would say a word in reference to applied entomology. This work cannot be done by one or several entomologists confined the year around to the Agricultural Department at Washington, where there are no extensive field or garden crops and forests. There might be formed a national board of entomologists, who should investigate cotton, wheat and corn insects, those infesting field and grass crops, and our forest and shade trees. They should not all be required to live at Washington, but work where the material is at hand; they should, therefore, divide the subject among themselves, prepare special bulletins, final reports and manuals for the diffusion of a genuine knowledge of insects, of which there are probably from 50,000 to 100,000 species on this continent. Such work would, we believe, do an immense deal towards multiplying local observers, diffusing a knowledge of applied and scientific entomology among the masses, would develop the teaching of useful natural knowledge in the common schools, increase the number of scientific entomologists and general biologists, and would eventually place the sciences of botany and zoölogy upon the same level which they hold in other countries, and in the end add immensely to the natural resources of our soil and increase our national wealth.

—— The Academy of Natural Sciences of this city, has filled two more of the chairs, which it created four years ago, with competent professors. The two courses of lectures, on invertebrate palæontology, and mineralogy and stratigraphic geology, are an important acquisition to the educational facilities of the city, and will also serve to strengthen the scientific back-bone of the Academy. The institution is to be congratulated on having made such an important advance, and in having given such merited recognition to Messrs. Heilprin and Lewis.

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RECENT LITERATURE.

WALLACE'S ISLAND LIFE.[1]—After the publication of his work entitled, "The Geographical Distribution of Animals," Mr. Wallace devoted four years' additional thought and research in

[1] *Island Life or the Phenomena and Causes of Insular Faunas and Floras*, including a Revision and attempted solution of the Problem of Geological Climates. By ALFRED RUSSELL WALLACE. New York, Harper & Brothers, 1881. 8vo, pp. 522.

the same direction, with the result before us, a book rather more popular in its treatment of the general subject, and a little narrower in scope in those chapters confined to a discussion of the causes governing the peopling of the larger oceanic and continental islands. The result is a most interesting work, and one which will serve to maintain, if not greatly advance the general interest felt by naturalists in the general and attractive subject of the philosophy or explanation of the causes of the present geographical distribution of plants and animals.

The author attempts to explain the present distribution of life by reference to a complex of causes grouped as biological and physical. The biological causes are (1) the constant tendency of organisms to increase in numbers and to spread out, disperse and migrate; and (2) "those laws of evolution and extinction, which determine the manner in which groups of organisms arise and grow, reach their maximum, and then dwindle away, often breaking up into separate portions which long survive in very remote regions." The physical causes are (1) "geographical changes which at one time isolate a whole fauna and flora, at another time lead to their dispersal and intermixture with adjacent faunas and floras;" and (2) the changes of climate which have occurred in various parts of the earth. A good deal of space is devoted to the subject of geological climates and their causes, and this inquiry has led to an investigation of the mode of formation of stratified deposits, with a view to fix within some limits their probable age, also to obtain a rough estimate of the probable rate of development of the organic world; both of these processes being shown to involve, in all probability, periods of time less vast than have generally been thought necessary. These subjects are discussed in the author's clear, pleasing and popular style in the first part. And it is in this part that our readers will take the liveliest interest. The second part is an explanation of the phenomena presented by the floras and faunas of the chief islands of the globe.

Returning to the first part, among the more general results of modern science, which Mr. Wallace utilizes for his purpose, is the doctrine now gaining wide acceptance in Europe, and which had been taught by Dana and Agassiz years ago in this country, namely that of the general stability of continents; that the "grand features of our globe—the position of the great oceans and the chief land-areas—have remained, on the whole, unchanged throughout geological time." The continents have been built up mainly of shore deposits. "The general stability of continents has, however, been accompanied by constant changes of form, and insular conditions have prevailed over every part in succession." We shall refer farther on to this doctrine, and its vital influence on zoö-geography, a point apparently overlooked by Wallace and by most other writers on this subject.

Three chapters are devoted to the influence of the glacial epoch

on the climate of the globe, and to the question of past glacial epochs and their causes. Mr. Wallace while adopting generally Mr. Croll's views as to the causes of the glacial epoch, limits and modifies his views by pointing out the very different effects on climate of water in the liquid and solid state, and that without high land there can be no permanent snow and ice. He concludes that the "alternate phases of precession, causing the winter of each hemisphere to be in aphelion and perihelion each 10,500 years, would produce a complete change of climate only where a country was *partially* snow-clad; while, whenever a large area became almost *wholly* buried in snow and ice, as was certainly the case with Northern Europe during the glacial epoch, then the glacial conditions would be continued, and perhaps even intensified, when the sun approached nearest to the earth in winter, instead of there being at that time, as Mr. Croll maintains, an almost perpetual spring." He also opposes the views of Mr. Croll and others as to the existence of general glacial epochs in earlier times, and claims that "the geological evidence leads inevitably to the conclusion, that during a large portion of the Secondary and Tertiary periods, uninterrupted warm climates prevailed in the north temperate zone, and so far ameliorated the climate of the Arctic regions as to admit of the growth of a luxuriant vegetation in the highest latitudes yet explored." He accepts Croll's hypothesis that the glacial epoch began about 200,000 years ago.

Mr. Wallace although a Darwinian as such, is not so extreme in his demands of unlimited time for the action of natural selection as the majority of his school. He duly respects the claims of the mathematicians and astronomers that the earth's age is to be reckoned by tens of millions rather than by larger figures, and adopts Sir William Thompson's conclusion "that the crust of the earth cannot have been solidified much longer than 100,000,000 years;" and Professor Haughton's estimate that the time to be required to produce the maximum thickness of the stratified rocks of the globe (177,200 feet) at the present rate of denudation and deposition is only 28,000,000 years. Now these are only guesses, but yet are useful, as indicating the order of magnitude of the time required. Mr. Wallace therefore claims that "so far as the time required for the formation of the known stratified rocks, the hundred million years allowed by physicists is not only ample, but will permit of even more than an equal period anterior to the lowest Cambrian rocks, as demanded by Mr. Darwin."

"In the tenth edition of the Principles of Geology, Sir Charles Lyell, taking the amount of change in the species of mollusca as a guide, estimated the time elapsed since the commencement of the Miocene as one-third that of the whole Tertiary epoch, and the latter at one-fourth that of geological time since the Cambrian period. Professor Dana, on the other hand, estimates the Tertiary as only one-fifteenth of the Mesozoic and Palæozoic com-

bined. On the estimate above given, founded on the dates of phases of high eccentricity, we shall arrive at about four million years for the Tertiary epoch, and sixteen million years for the time elapsed since the Cambrian, according to Lyell, or sixty millions, according to Dana. The estimate arrived at from the rate of denudation and deposition (twenty-eight million years) is nearly midway between these, and it is, at all events, satisfactory that the various measures result in figures of the same order of magnitude, which is all one can expect in so difficult and exceedingly speculative a subject.

"The only value of such estimates is to define our notions of geological time, and to show that the enormous periods of hundreds of millions of years which have sometimes been indicated by geologists are neither necessary nor warranted by the facts at our command; while the present result places us more in harmony with the calculations of physicists, by leaving a very wide margin between geological time as defined by the fossiliferous rocks and that far more extensive period which includes all possibility of life upon the earth."

Another good point made by Mr. Wallace, and one to be commended to the consideration of ultra-conservative anti-evolutionists, is that the present condition of the earth is one of exceptional stability as regards climate, and that the result is an epoch of exceptional stability of species.

It will be seen by the extracts made and the general tone of this interesting work that the author has given us a calm, moderate and yet comprehensive survey of some of the most interesting problems of modern science.

Mr. Wallace not only discards some of the exaggerated hypotheses of well-nigh limitless geological periods, but also the far-fetched ideas of intercontinental bridges and temporary islands, which so excellent a biologist as Professor Huxley is fond of invoking even up to the present year, and of the hypothetical Lemuria of Haeckel, and has fully adopted the well-grounded view of the permanence of the present continents and ocean basins. To American geologists the origin of the North American continent from the Laurentian nucleus, and its gradual building up by sediments derived from the waste of its own rocks, is a familiar view. Keeping pace with this building up and extension of the continental land mass was the evolution of its flora and fauna, which have borrowed none of their features from the old world, though there may have possibly been an interchange of forms with the South American continent. It was not until near the close of the Tertiary, perhaps, that the American and Asiatic continents nearly met, and that it was possible for a slight interchange of forms to take place on the west, while possibly through Spitzbergen and other islands north of the European-Asiatic continent there may have been a slight interchange of forms. Simultaneous with the growth of the

American continent (considering North and South America for our purpose as one) the Europeo-Asiatic, African and Australian continents developed, with their characteristic assemblages of plants and animals.

We have been accustomed to teach for several years past, and have briefly stated the doctrine in our "Zoölogy"[1] that the different continents have been original distinct centers of distribution, and that analogous forms of life found in opposite continents have not necessarily been derived one from the other, but may have arisen through the influence of similar physical surroundings on different continents; in this way we would explain the origin of representative species. For example, the "Scandinavian" flora did not necessarily people America, but the flora now found in Northern and Arctic Europe probably originated over both Europe and America. The American opossums were not necessarily travelers from Australia by way of Europe, but more probably originated from the Mesozoic lands of North America. The American continent had its own marsupials, its own tapirs, its own Felidæ, Canidæ, horses, camels and monkeys, which independently evolved on American soil, while representative forms arose in Europeo-Asiatic lands. It seems to us that this view is a simple and natural one, in accordance with geological and palæontological facts. Did Mr. Wallace entertain similar views, it seems to us, he would find in such a reasonable theory a simple and ready explanation of many facts in zoö-geography which he now accounts for by extensive intercontinental migrations on a scale and extent which is opposed by many geological facts. This fact, as we regard it, of the independent evolution in different continents of representative genera and species, lies, it seems to us, at the basis of a rational explanation of many otherwise inexplicable problems. In the light of recent discoveries in American vertebrate palæontology and deep-sea explorations, the high antiquity and independent origin of our continental fauna as a whole seems well nigh proved. Of course, when we come to the glacial period, when the continents of America and Asia approached each other, there were possibly interchanges of species, and extensive migrations from north to south, with wide-spread extinctions, which renders the distribution

[1] Zoölogy for High Schools and Colleges. By A. S. Packard, Jr. New York, 1879. "The earth's surface may then be mapped out into general and special divisions. First, a tropical, temperate, and arctic or circumpolar fauna or realm; and, secondly, each continent may form a smaller subdivision or specific center—*i. e.*, the Europeo-Asiatic, the African, the Australian, and the South and North American regions, for each of these continental divisions have been peopled with types of animals which have been from the earliest geological times the original possessors of the soil, though they may have adopted members of each other's faunæ," p. 662. "It appears, then, that each continent has had from the first its distinct assemblage of life, and thus opposing continents, such as South America and Africa, have fundamentally different faunæ, because they have had a separate geological history." Ibid, p. 664.

of life in the northern hemisphere in the Quaternary so different from that of the Tertiary.

The only European naturalist, so far as we are aware, who has insisted on the independent origin of the different continental floras and faunas is Professor Carl. Vogt, in a recent article published in Westermann's Monatshefte, where he vigorously discusses the subject, and claims that the monogenists, or those who believe that different types have arisen from a single individual, are in the wrong; that different continents may have simultaneously produced representatives or similar species; and that we should not accept a single center of creation for all faunas.

Naturalists are again indebted to Mr. Wallace for an original work in a field which he has gleaned so successfully, bringing back to the storehouse of science a sheaf of genuine facts abounding with ripe inductions and containing but little chaff.

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Gli Strati a Congerie e le Marne Compatte Mioceniche dei Dintorni di Ancona. (Reale Accad. dei Lincei, 1878–79.) pp. 26, 3 plates. Rome, 1879.

Balenottera Fossile delle Colombaie presso volterra. (Reale Accad. dei Lincei, 1878–79.) pp. 8. Rome, 1879.

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Description of two new species of Scopeloid Fishes, Sudis ringens and Myctophum crenulare, from Santa Barbara channel, California, pp. 8.—

Description of seven new species of Sebastoid Fishes from the Coast of California. pp. 12.—

Description of a new Embiotocoid (Abeona aurora) from Monterey, California, with notes on a related species. pp. 3.—

Description of a new Flounder (Platysomatichthys stomias) from the coast of California. pp. 2.—

Description of a new species of Paralepis (Paralepis coruscans), from the Straits of Juan de Fuca. pp. 3.—

Description of a new Scorpænoid Fish (Sebastichthys proriger) from Monterey bay, California. pp. 5. By David S. Jordan and Charles H. Gilbert. (From Proc. United States Nat. Mus., 1880.) From the authors.

Note on a new Flat-fish (Lepidopsetta isolepis) found in the markets of San Francisco. By W. N. Lockington. (From Proc. U. S. Nat. Mus., 1880.) 1 page. From the author.

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First Annual Report of the Board of State Viticultural Commissioners (California). Containing the First Report of the Committee on the Phylloxera, Vine Pests and the Diseases of the Vine. With Appendices A. to J. pp. 1–82. San Francisco, 1881.

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GENERAL NOTES.

BOTANY.[1]

A Reformed System of Terminology of the Reproductive Organs of the Thallpohyta.—At the Swansea meeting of the British Association in August, 1880, Professor A. W. Bennett and

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

George Murray, presented a paper bearing the title given above. The following summary is furnished to the NATURALIST, by the authors of the paper:

In the fourth edition of his "Lehrbuch," Sachs defines a "spore" as "a reproductive cell produced directly or indirectly by an act of fertilization," reserving the term "gonidium" for those reproductive cells which are produced without any previous act of impregnation. The practical objections to this limitation of terms are pointed out, and it is proposed to restore the term spore to what has been in the main hitherto its ordinary signification, viz.: *any cell produced by ordinary processes of vegetation and not by a union of sexual elements, which becomes detached for the purpose of direct vegetative reproduction.* The spore may be the result of ordinary cell-division or of free cell formation. In certain cases (zoöspores) its first stage is that of a naked mass of protoplasm; in rare instances it is multicellular, breaking up into a number of cells (polyspores, composed of merispores, or breaking up into sporidia). Throughout thallophytes the term is used in the form of one of numerous compounds expressive of the special character of the organ in the class in question. Thus, in the Protophyta and Mucorini we have chlamydospores; in the Myxomycetes, sporangiospores; in the Peronosporeæ, conidiospores; in the Saprolegnieæ, Oöphyceæ, and some Zygophyceæ, zoöspores; in the Uredineæ, teleutospores, æcidiospores, uredospores, and sporidia; in the Basidiomycetes, basidiospores; in the Ascomycetes (including Lichenes), conidiospores, stylospores, ascospores, polyspores, and merispores; in the Hydrodictyeæ, megaspores; in the Desmidieæ, auxospores; in the Volvocineæ and Mesocarpeæ, parthenospores; in the Siphoneæ and Botrydieæ, hypnospores; in the Œdogoniaceæ, androspores; in the Florideæ, tetraspores and octospores. The cell in which the spores are formed is in all cases a sporangium.

In the terminology of the male fecundating organs very little change is necessary. The cell or more complicated structure in which the male element is formed is uniformly termed an antheridium, the ciliated fecundating bodies, antherzoids (in preference to "spermatozoids") In the Florideæ and Lichenes, the fecundating bodies are destitute of vibratile cilia; in the former case they are still usually termed "antherozoids," in the latter "spermatia," and their receptacles "spermogonia." In order to mark the difference in structure from true antherozoids, it is proposed to designate these motionless bodies in both cases pollinoids; the term "spermogonium" is altogether unnecessary, the organ being a true antheridium.

A satisfactory terminology of the female reproductive organs presents greater difficulties. The limits placed to the use of the term spore and its compounds require the abandonment of "oöspore" for the fertilized oösphere in its encysted stage anterior

to its segmentation into the embryo. The authors propose the syllable *sperm* as the basis of the various terms applied to all those bodies which are the immediate result of impregnation. It is believed that it will be found to supply the basis of a symmetrical system of terminology which will go far to reduce the confusion that at present meets the student at the outset of his researches. For the unfertilized female protoplasmic mass, it is proposed to retain the term oösphere, and to establish from it a corresponding series of terms ending in *sphere*. The entire female organ before fertilization, whether unicellular or multicellular, is designated by a set of terms ending in *gonium*.

In the Zygomycetes and Zygophyceæ, the conjugated zygospheres, or contents of the zygogonia, constitute a zygosperm; in the Oömycetes and Oöphyceæ the fertilized oösphere, or contents of the oögonium, is an oösperm; in the Carpophyceæ the fertilized carposphere, or contents of the carpogonium, constitutes a carposperm. In this last class the process is complicated, being effected by means of a special female organ which may be called the trichogonium (in preference to "trichogyne"). The ultimate result of impregnation is the production of a mass of tissue known as the cystocarp (or "sporocarp"), within which are produced the germinating bodies which must be designated carpospores, since they are not the direct results of fertilization. Any one of these bodies which remains in a dormant condition for a time before germinating is a hypnosperm. In the Cormophytes (Characeæ, Muscineæ, and vascular cryptogams) the fertilized archesphere, or contents of the archegonium, is an archesperm. In the proposed system zygosperm will replace Strasburger's "zygote," and the "gametes" of the same writer will be zygospheres, his "zoögametes" or "planogametes" being zoözygospheres.

In the Basidiomycetes, Ascomycetes and some other classes, it is proposed to substitute the term *fructification* for "receptacle" for the entire non-sexual generation which bears the spores.

Modes of Fertilization in Cryptogams.

ZYGOSPERMEÆ.	Zygogonia, containing Zygospheres, producing after fertilization a Zygosperm.	
	Male Organ.	*Female Organ.*
OOSPERMEÆ.	Antheridium, containing Antherozoids or Pollinoids.	Oogonium, containing Oosphere, producing after fertilization an Oosperm.
CARPOSPERMEÆ.	Antheridium, containing Antherozoids or Pollinoids.	Carpogonium, containing Carposphere, producing after fertilization a Carposperm.
CORMOPHYTA.	Antheridium, containing Antherozoids.	Archegonium, containing Archesphere, producing after fertilization an Archesperm.

Reproductive Organs of Thallophytes.

	Non-sexual.
PROTOPHYTA.	Chlamydospore. Sporangium.

	Female.	*Non-sexual.*
MYXOMYCETES.		Zoöspore. Sporangiospore.
MUCORINI.	Zygogonium. Zygosphere. Zygosperm.	Chlamydospore. Sporangiospore.
PERONOSPOREÆ.	Oögonium. Oösphere. Oösperm.	Sporangium. Conidiospore. Zoöspore.
SAPROLEGNIEÆ.		Zoöspore.
UREDINEÆ.	Carpogonium. Carposphere. Carposperm.	Teleutospore. Æcidiospore. Uredospore. Sporidium.
USTILAGINEÆ.		Teleutospore. Sporidium.
BASIDIOMYCETES.		Basidiospore. Sterigma. Basidium.
ASCOMYCETES, including LICHENES.	Trichogonium.	Conidiospore. Stylospore. Ascospore. Polyspore. Merispore.
ZYGOPHYCEÆ.	Zygogonium. Zygosphere. Zoözygosphere. Zygosperm. Hypnosperm (Hydrodictyeæ, Zygnemaceæ).	Zoöspore. Megazoöspore (Hydrodictyeæ). Auxospore (Diatomaceæ). Hypnosporangium } Botrydieæ. Hypnospore Parthenospore (Mesocarpeæ).
OOPHYCEÆ.	Oögonium. Oösphere. Oösperm. Conceptacle. Hypnosperm.	Zoöspore. Parthenospore (Volvocineæ). Androspore (Œdogoniaceæ). Hypnospore (Siphoneæ).
CARPOPHYCEÆ.	Corpogonium. Carposphere. Carposperm. Trichogonium. Trichophore. Cystocarp.	Zoösporangium. Tetraspore. Octospore. Carpospore.

CURTISS' "NORTH AMERICAN PLANTS."—As is well known to many readers of the NATURALIST, Mr. A. H. Curtiss, of Jacksonville, Florida, has for several years been engaged in issuing annual fascicles of the more interesting North American plants, particularly of the southern species. Fascicle No. IV has just appeared, and, like its predecessors, it consists of beautifully preserved specimens. In turning over the numbers there is scarcely an inferior specimen to be found, and not one *poor* one.

The species are distributed quite evenly throughout the phanerogamia, and there are, besides, a few vascular cryptogams.

Many of the species are peculiar to South Florida, and will be valuable acquisitions to many herbaria. Quite a number of Texan species are represented by specimens collected by Mr. J. Reverchon. Among the species which will be interesting to many northern botanists may be mentioned *Vitis sicyoides* Benth. and Hook., a curious member of the Cissus sub-genus, and not at all grape-like in appearance; *Acer saccharinum* Wang. var *Floridanum* Chap., with its petite leaves and fruits; *Strumpfia maritima* Jacq., which has twigs and foliage with a decidedly coniferous look; *Garberia fruticosa* Gray; *Mimusops Sieberi* A. DC.; *Jacquinia armillaris* Jacq.; *Thrinax Garberi* Chap.; *Monanthochloë littoralis* Eng.

The Function of Lichen Gonidia.—George Murray, in the *Journal of the Linnean Society*, for October, attempts to apply the results of Pringsheim's recent researches on chlorophyll to the life of the lichen. The new view as to the function of chlorophyll is that instead of being the active agent in the decomposition of CO_2, it discharges the office of a screen to the protoplasm, which itself is the decomposing agent. Mr. Murray suggests that in lichens we have an experimental proof of the truth of this theory. "We have the lichen, the fungal tissues, as the body of the thallus, and the chlorophyll screen, in the gonidial layer; that is, the chlorophyll is in one system of cells and the protoplasm apparently affected by it in another, which is in contact. The light which traverses the chlorophyll-containing gonidial layer excites in the fungal tissues the decomposition of CO_2 In evidence of this I would point to the plentiful occurrence of starch, or rather lichenin, a substance of the same chemical composition as starch ($C_{12}H_{20}O_{10}$), and formed from it according to Masche (*Jour. Prakt. Chemie*, LXI, p. 7), by the action of the free acids of the plant. Further, I venture to submit that this process tends to explain the nature of the consortism of the fungal and algal elements in the autonomous lichen, and to support the well-known views of Schwendener."

Sets of North American Fungi.—It is impossible for the student of fungi to make much progress in the identification of species without having access to collections of authentic and well mounted specimens. In 1878, Mr. J. B. Ellis, of Newfield, N. J., began the distribution of his sets of "North American Fungi," and has continued the work with such rapidity that up to the present no less than five hundred species have been prepared and issued by him. Century V, sent out during January of this year, is a valuable one to the fungologist. Nearly all the orders of fungi are represented by species, there being of the Calcareæ (Myxomycetes) 1; of the Perisporiaceæ 9; the Helvellaceæ 22; Phacidiaceæ 11; Pyrenomycetes 35; Hymenomycetes 11; and of imperfect forms (probably of some Ascomycetes) 11. The

specimens are in generous quantity for each species, and in most cases are put up loosely in envelopes pasted to the pages, thus making them doubly valuable for microscopical study.

Pinus Banksiana Lamb., on the Sea Coast of Maine.—Mr. C. G. Atkins, of Bucksport, Me., reports finding trees of this species in Orland, Hancock county, Me., and also in Washington county, near Harrington. The same tree was reported to him as growing on Cape Rosier, Schoodic point, and Beal's island. This pine has hitherto been catalogued as confined to "the northern borders" of Maine.

In this connection it may be well to point out that Professor Babcock in his "Flora of Chicago and Vicinity" (*The Lens*, 1872), records this species as being "abundant for several miles along the L. S. & M. S. R. R.," near the city; a locality not noted in our books and catalogues.

Bentham's New Classification of the Orchids.—At the meeting of the Linnean Society, Jan. 20, 1881, Bentham presented an important paper embodying the results of his detailed examination of all the genera proposed or established. He re-arranges them under five tribes and twenty-seven sub-tribes, as follows:

Tribe I. Epidendreæ.

Sub-tribe 1. Pleurothalleæ.
" 2. Microstyleæ.
" 3. Liparieæ.
" 4. Dendrobieæ.
" 5. Erieæ.
" 6. Bletieæ.
" 7. Coelogyneæ.
" 8. Stenoglosseæ.
" 9. Lælieæ.

Tribe II. Vandeæ.

Sub-tribe 1. Eulophieæ.
" 2. Cymbidieæ.
" 3. Cyrtopodieæ.
" 4. Stanhopieæ.
" 5. Maxillarieæ.
" 6. Oncidieæ.
" 7. Sarcantheæ.
" 8. Notyileæ.

Tribe III. Neottieæ.

Sub tribe 1. Vanilleæ.
" 2. Corymbieæ.
" 3. Spirantheæ.
" 4. Diurideæ.
" 5. Arethuseæ.
" 6. Limodoreæ.

Tribe IV. Ophrydeæ.

Sub-tribe 1. Serapiadeæ.
" 2. Habenarieæ.
" 3. Diseæ.
" 4. Corycieæ.

Tribe V. Cypripedieæ.

Botanical News.—Mr. D. L. James has published in the Journal of the Cincinnati Society of Natural History (January, 1881), a valuable paper entitled "Notices of the Floras of Cincinnati, published from 1815 to 1879," in which he enumerates and comments upon the published lists, four in number.——Dr. Killebrew, the Commissioner of Agriculture of the State of Tennessee, has recently issued from his office a pamphlet of 164 pages on "Meadows and Pastures." The general treatment of the subject is much like that followed in Flint's "Grasses and Forage Plants," but it is much simplified so as to be more easily read by those who are not botanists. It is a valuable little work, and although not written for botanists, will prove interesting to

them also.——Dr. Vines in the January *Journal of Botany* publishes a "History of the Scorpioid Cyme." The term has been used in two senses, resulting in considerable confusion; in the one sense it is made to include the helicoid cyme, while in the other the scorpioid and helicoid cymes are distinct. The latter which appears to be the best usage is, in the books used in this country, followed in Gray's Botanical Text Book, 6th edition; Bessey's Botany for High Schools and Colleges; Prantl's Text Book of Botany; McNab's Botany and Sach's Text Book of Botany. The erroneous usage is followed in Wood's Class Book of Botany; Wood's Botanist and Florist; Thome's Structural and Physiological Botany; Youman's Second Book of Botany; and the old edition of Gray's Botanical Text Book. In Dr. Vines' paper by an unfortunate printer's blunder, Figs. 1 and 2 are transposed.——An important work on the Morphology of the Florideæ by Agardh, has recently been published in Leipsic.——Dr. Kuntze has been studying the "Gulf Weed" *(Sargassum bacciferum)*, and finds that there are several species, instead of but one, as has commonly been supposed. His results are given in his recently published treatise, *Revision von Sargassum und das sogennante Sargasso-Meer*." Leipsic, 1880.——Borzi describes a new Sardinian species of oak *(Quercus Morisii)* in the January number of *Nuovo Giornale Botanico Italiano*. It is apparently much like our Californian *Quercus agrifolia*.——In the January Bulletin of the Torrey Botanical Club, Francis Wolle describes, and figures twelve new species of North American desmids. ——The editors of the *Botanical Gazette* began in the February number, the issue in a four page extra of a catalogue of the plants of Indiana——From experiments made under the direction of Professor Hilgard upon the grounds of the University of California "it seems evident," to quote the words of the report, "that there must exist localities in California with winters warm enough for the three more hardy kinds of Cinchona *(C. succirubra, C. officinalis*, and *C. condaminea)*. In the same report the date palm *(Phœnix dactylifera)* is said to be "even as a young seedling, perfectly hardy" upon the University grounds.——"The Plants of the Summit of Mt. Marcy" is the title of an interesting pamphlet by C. H. Peck, the State Botanist of New York, reprinted from the Seventh Report of the Adirondack Survey. Upon the open summit 137 species were found, distributed as follows; algæ, 1; fungi, 7; lichens, 31; hepaticæ, 10; mosses, 32; lycopods, 3; gymnosperms, 3; angiosperms, 50.——Thomas Meehan has recently reprinted in the *Gardener's Monthly*, and in pamphlet form, his paper on the Objects of Sex, and of Odor in Flowers, read before the A. A. A. S. at Saratoga, 1879.——J. G. Baker's "Synopsis of the Aloineæ and Yuccoideæ," fills ninety-three pages of the October and December numbers of the *Journal of the Linnean Society*. It contains full descriptions of all the spe-

cies.——Dr. E. L. Sturtevant of South Framingham, Mass., has undertaken an investigation involving the ratios between the weight of fruits and their contained seeds; the number of perfect, shriveled and abortive seeds, etc. He has printed blanks which he asks observers in different parts of the country to fill and forward to him.——Uhlworm's *Botanisches Centralblatt* for 1881, fully sustains its high character. The promptness of its notices of botanical publications and papers is a source of wonder as well as of profit to its readers.——Botanists will be glad to learn that Centuries V and VI, of Ravenel's "Fungi Americani" are now nearly ready for distribution.

ZOÖLOGY.

VALUE OF THE HOUSE WREN AS AN INSECT DESTROYER.—Ornithologists and entomologists are always most properly and sensibly urging upon people the duty and necessity of protecting the birds. In fact, when any destructive insect appears in overwhelming numbers, the good offices of our feathered friends would seem to be almost our sole dependence for protection from their ravages. And yet our laws and usages are singularly defective, regarded simply from a selfish point of view—leaving humanity entirely out of the question. But the matter is constantly forcing itself upon public attention, and gradually we shall make laws which ought to have been upon our statute books from the foundation of the Government. In the meantime let us all, who have this subject at heart, keep on "preaching" until this glorious end is achieved. The observations I have been able to make during a residence of several years on a farm have convinced me that the common house wren is really one of our most valuable birds, not, perhaps, for what they have done, but from the possibilities wrapped up in their diminutive bodies. They are quite as social as the purple martin or the bluebird, and greatly surpass both of these in the rapidity with which they increase. I began several years ago to provide them with nesting-places in the vicinity of my buildings. Sometimes I fastened the skull of a horse or ox, or a small box, in a tree-top. But latterly I have made it a practice every spring to obtain thirty or forty cigar boxes for this purpose. If the box is long and large, I put a partition across the middle and make a hole through into each apartment. It it very seldom that these boxes are not occupied by one of these little families. In most instances two broods are annually reared in each nesting-place. One of my boxes last season turned out three broods of young wrens—six little hungry birds each time, or eighteen in all! I think a cigar box never before did better duty. The lamented Robert Kennicott stated that a single pair of wrens carried to their young about a thousand insects in a single day! Like all young, rapidly growing birds, they are known to be most voracious eaters, living entirely upon insects.

The point upon which most stress may be laid is this: That by providing them with nesting-places in our gardens, orchards or grounds, and not allowing them to be caught by cats or scared away by mischievous boys, we may have scores if not hundreds of them about us during most of the time in which insects are destructive. They undoubtedly return to the same localities to rear their young year after year. Last season I had up about thirty of these nesting-boxes, and all but two or three, which were not favorably located, were occupied. My crop of wrens could scarcely have been less than one hundred and fifty, and the old birds filled the air with music when they were not on duty in building their nests or feeding their young! The coming spring I intend to put up at least a hundred of these nesting-boxes in my orchards and groves, and I have no doubt I shall be repaid a hundred thousand fold for the little labor it costs. As long as they come back so regularly every year and in constantly increasing numbers, and serve me so well, I shall do all in my power to protect and encourage them. And I am of the opinion that when one species of social, useful birds can be made to congregate in such unusual numbers, others will come also. But the hardiness, sociability, love of the locality where it was reared, and wonderful fecundity of the little house wren, render it, in my judgment, one of the most valuable of all our insectivorous birds.—*Charles Aldrich, Webster City, Iowa, 1881.*

Our Social Blue-Jays.—None of our winter birds are so social as the blue-jays. We see them every day during our long, cold winters. Our barnyards are their favorite resorts, where they walk about very familiarly among the poultry and domestic animals, feeding upon the scattered or half-digested corn. Last night (Jan. 6), while I was passing a straw stack, a jay went whirling out of a small hole into which it had crawled a foot or more. This morning, as I write, the mercury is down to 24, so I suppose my jay had made the best possible provision to protect himself from the approaching low temperature. These birds and our little chickadees seem able to endure such extreme cold better than any others that remain with us all the year round. Soon after sunrise on any of these cold, clear mornings, they can be heard merrily chirping in the neighboring groves and thickets. —*Charles Aldrich, Webster City, Iowa, Jan. 7, 1881.*

Zoological Notes.—M. Jules MacLeod has contributed a brief paper to the Royal Academy of Belgium on the *rôle* of insects in the pollinization of heterostyle flowers (*Primula elatior*).——Mr. S. H. Scudder continues in the Library Bulletin of Harvard University, No. 17, his bibliography of fossil insects, beginning with A. G. Butler and ending with d'Eichwald.——A structural feature hitherto unknown among Echinodermata, found in deep-sea Ophiurans, is pointed out by Mr. T. Lyman in an essay under this title in the Anniversary Memoirs of the Boston Society of Natural

History. The feature in question consists of branches of minute spines of different forms, some resembling long-stemmed agarics or parasols with small shades. The question whether these novel shapes are spines or pedicellariæ or not, is not regarded by Mr. Lyman as a very important one, "since the pedicellaria is only a spine peculiarly modified. But it may be said that their supplementary character and abnormal shape give these parasol spines the position of what used to be carefully distinguished as pedicellariæ." Mr. Lyman has also distributed a preliminary list of the known genera and species of living Ophiuridæ and Astrophytidæ, with their localities, and the depths at which they have been found; and references to the principal synonyms and authorities, Cambridge, December, 1880.——The heart of the Stomapod Crustacea is said by Claus in *Zoologischer Anzeiger* to consist of an anterior heart-like wider section, and of an elongated many-chambered dorsal vessel, the anterior part corresponding with the Decapod heart and situated in the region of the maxillæ and maxillipedes. The dorsal vessel has twelve pairs of venous openings, and sends off thirteen pairs of lateral arteries as well as a posterior aorta. A median ventral artery is present extending the whole length of the ventral nervous cord, and a sympathetic nerve extends along the dorsal side of the dorsal vessel, forming a large ganglion cell on each chamber.——In the same journal for November 29, Dr. Krancher writes on the structure of the stigmata of insects. He distinguishes five types; of simple stigmata without lips, two forms, the simplest (1) representing a hole surrounded by a chitinous ring, and (2) where the stigma consists of a row of single stigmata surrounded by a common chitinous ring, and whose tube-like continuations form the trachea. Of stigmata with lips, the lips (3) are represented by a simple sparsely haired chitinous ridge; (4) the lips are roof-like, extended inwards, and show a luxuriant growth of hairs like felting, and (5) the round stigma has on one side a median piece extending into the center. He states that there are never more than ten pairs of stigmata.——In an interesting report on the edible fishes of the Pacific coast in the Report of the Commissioners of Fisheries of the State of California for 1880, Mr. W. N. Lockington gives some novel information in regard to the hag fish of that coast *(Polistotrema dombeyi).* While at Monterey he was shown, by Prof. D. S. Jordan, several rock cod which had been literally eaten alive by them and had washed ashore as mere shells. The hag enters by the gills, or occasionally by devouring the eye, and eats its way into the flesh of its victim, consuming it until it dies of weakness, but presumably leaving, like the ichneumons that prey upon caterpillars, the vital parts untouched until the last. The hag is fitted for its work by its suctorial mouth, which is terminal, soft, not provided with jaws, and forming a round opening when in use, as well as by two teeth on each

side of the gullet. The mouth is surrounded by barbels, and in preserved examples is scarcely visible. The fishermen of Monterey declare that one of these parasitic fishes will devour a fish of six or eight pounds weight in a single night. It is especially destructive to fish taken in gill-nets. When the hulk is taken out of the net, the hag scrambles out with great alacrity. It reaches a length of fourteen inches, and is not used for food at Monterey. ——Prof. Verrill has described in the Proceedings of the National Museum, a large number of new mollusks, echinoderms, annelids, etc., many of which were obtained last summer in the remarkably successful dredging explorations of the U. S. Fish Commission about one hundred miles south of Newport, R. I., upon the slope of the continent where it plunges under the Gulf Stream. Among the most interesting discoveries were nearly fresh shells of *Argonauta argo*, which indicate that this shell must often be common near our coast. Quantities of a large, handsome but very fragile cup-coral (*Flabellum goodei* Verr.) occurred. While many of the species of every class obtained are Arctic or belong to the cold waters found at similar or greater depths on the coasts of Europe and in the Mediterranean, a few genera, like Avicula, Solarium and Marginella are related to southern or West Indian forms. Though the very large collections of specimens obtained on these three trips of the *Fish-hawk* have, as yet, been only partially examined, enough has already been done to prove this region to be altogether the richest and most remarkable dredging ground ever discovered on our coast. As we have before remarked, the scientific results of the work of the U. S. Fish Commission are of the highest value; were it not for Government aid in this direction, to say nothing of the practical value of such researches, as showing where and on what kind of food our edible sea fishes live in winter, we could never, by private enterprise, have arrived at the knowledge of our marine fauna which we now possess, nor have got at many facts in distribution which bear on geological and palæontological problems.——The *Bulletin* of the Museum of Comparative Zoölogy, Vol. VIII, No. 1, contains a preliminary study of the Crustacea dredged in the Gulf of Mexico by the U. S. coast survey steamer *Blake* in 1877, '78 and '79, by M. Alphonse Milne-Edwards; Mr. Alexander Agassiz being the naturalist of the expedition.——Although one of the toughest of mollusks, it appears, on the authority of Mr. A. W. Roberts in the *Scientific American*, that the winkle (*Sycotypus canaliculatus*) may be added to our list of edible mollusks, from the fact that a colony of colored people back of Keyport, N. J., known as "Winkle Town," live largely on these shell-fish.

ENTOMOLOGY.[1]

THE FRENCH STILL LOOKING TOWARD AMERICAN VINES.—The latest London papers bring information concerning the French Superior Commission on the Phylloxera, which lately held its final sitting under the presidency of the Minister of Agriculture and Commerce. The introduction of American stocks into the department of the Gironde was authorized. The commission then decided that no one had gained the £12,000 prize for an efficient remedy. The remedies approved by the commission continue to be, as before, submersion, sulphur of carbon and sulphocarbonate of potassium. They recommend further the continuance of State aid to those departments which are attempting the reconstitution of their vineyards by the aid of American descriptions. In certain departments this attempt has hitherto proved very successful. The nursery established at Saintes (Charente Inferieur) distributed last year 7000 roots and this year 30,000, and further anticipated providing double if not triple the last number next year, with the promised aid of Government.—*Pacific Rural Press.*

LEGISLATION TO CONTROL INSECTS INJURIOUS TO VEGETATION.—Professor C. H. Dwinelle, of the University of California, has been appointed by the California State Horticultural Society as a member of a committee to consider what legislation is desirable to check the spreading of noxious insects, and force land-owners to destroy them when practicable.

The committee has in mind a commission with power to investigate and abate nuisances in the way of neglected breeding grounds of insect pests, codling moth, scale insects, etc. They expect to be met by objections from the free American citizen, standing upon his constitutional right to do as he pleases with his own property, but they question his right to maintain an orchard which is unprofitable to himself and a pest in the neighborhood.

No laws have been passed in this country obliging the destruction of injurious insects, except in the case of the destructive locust of the West. These laws are given in the first report of the U. S. Entomological Commission on this insect. They have passed laws both in France and Germany to oblige the gathering of caterpillars, their eggs, etc., from fruit and shade trees. They also have in those countries many police regulations regarding the destruction of injurious insects and the prevention of injury to agriculture, forestry and horticulture. The local authorities have full power to rigidly enforce these laws and regulations, which, on the whole, do a great deal of good. The whole population of a district which is invaded by an insect enemy is, in case of emergency, at the command of the authorities, and what can

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

be accomplished by such concerted and well-directed action is shown by the heading off of the threatened invasion of the Colorado potato-beetle some years ago. Of course such laws could not be very well enforced in this country; but we see no objection to a committee of surveillance empowered to order the suppression of certain insects at any particular point where such are allowed to multiply unchecked, to the injury of the neighborhood. A penalty might be attached for the non-performance of work ordered by such committee, as in the case of all other laws requiring work for the common good. That intelligent suppression, in this manner, of many insects, such as scale-insects, Phylloxera, or even of fungus diseases, would be productive of much general good in preventing the spread of, or in decreasing, injury, there can be no question, and we sincerely hope that our California friends will succeed in their efforts to get such a law.—*C. V. R. in Farmers' Review.*

On some Interactions of Organisms.—We have received an advance copy of a brochure with this title by Professor S. A. Forbes, extracted from Bulletin No. 3 of the Illinois State Laboratory of Natural History. It contains some thoughts and generalizations that have grown out of that writer's studies on the food of birds, insects and fishes, and the interrelation and interdependence of these animals. Professor Forbes finds that it is extremely unlikely that a species injurious to man's interest and well-being can ever be exterminated or even permanently lessened in numbers by a parasite strictly dependent upon it. This is a conclusion which greatly diminishes the importance of parasitism in the warfare by man against insects or other animals injurious to him, whether directly or indirectly. He rightly maintains that the interests of a species of plant or animal and the interests of its enemies "are identical, and since the operations of natural selection tend constantly to bring about an adjustment of the species and its enemies which shall best promote this common interest; therefore, *the annihilation of all the established 'enemies' of a species would, as a rule, have no effect to increase its final average numbers.* This being a general law, applying to all organisms, it is plain that the real and final limits of a species are the inorganic features of its environment,—soil, climate, seasonal peculiarities, and the like."

He contends that we get more protection against the inordinate increase of noxious insects, from predaceous birds and predaceous insects which eat a mixed food, because in the absence or diminution of any one element of their food their own numbers are not seriously affected, and, as a consequence, they are more generally ready, upon occasion, for effective attack on a threatening foe than any special parasite can be whose increase and decrease are more intimately dependent upon the increase and decrease of its prey. Reasoning from this standpoint the superiority of insectivorous birds becomes plainly manifest, their wing power en-

abling them to escape scarcity in one region which might otherwise decimate them, by simply passing to a more favorable region where they can find food. It does not follow, however, from these facts that the indefinite multiplication of either birds or insects is beneficial, since there is a limit beyond which such multiplication becomes harmful.

We recommend and heartily endorse the following concluding passages from the paper:

"We are therefore sure that the destruction of any species of insectivorous bird or predaceous insect is a thing to be done, if at all, only after the fullest acquaintance with the facts. The natural presumptions are nearly all in their favor. It is also certain that the species best worth preserving are the mixed feeders and not those of narrowly restricted dietary (parasites, for instance) —that while the destruction of the latter would cause injurious oscillations in the species affected by them, they afford a very uncertain safeguard against the *rise* of such oscillations. In fact, their undue increase would be finally as dangerous as their diminution. * * *

"When we compare the results of the primitive natural order with the interests of man, we see that, with much coincidence, there is also considerable conflict. While the natural order is directed to the mere maintenance of the species, the necessities of man usually require much more. They require that the plant or animal should be urged to excessive and superfluous growth and increase, and that all the surplus, variously and widely distributed in nature, should now be appropriated to the supply of human wants. From the consequent human interferences with the established system of things, numerous disturbances arise, many of them full of danger, others fruitful of positive evil. Oscillations of species appear, not less injurious to man than to the plants and animals more directly involved. Indeed, most of the serious insect injuries, for example, are due to species whose injurious oscillations have resulted from changes of the organic balance initiated by man.

"To avoid or mitigate the evils likely to arise, and to adapt the life of his region more exactly to his purposes, man must study the natural order as a whole, and must understand the disturbances to which it has been subject. Especially, he must know the forces which tend to the reduction of these disturbances, and those which tend to perpetuate or aggravate them, in order that he may reinforce the first, and weaken or divest the second.

"The main lesson of conduct taught us by these facts and reasonings, is that of conservative action and exhaustive inquiry. Reasoning unwarranted by facts, not correctly and sufficiently reasoned out, are equally worthless and dangerous for practical use."

BARON de Chaudoir, of Russia, R. H. McLachlan, of England, and Baron C. R. Osten Sacken, formerly Russian Consul General

to this country, have been elected honorary members of the Belgian Entomological Society to fill the vacancies caused by the deaths of Boisduval, Mulsant and Snellen van Vollenhoven.

INSECT LOCOMOTION.—M. G. Carlet, of France, has been studying the locomotion of insects and arachnids, and reports as the result of his observations that the walking of insects may be represented by that of three men in Indian file, the foremost and hindmost of whom keep step with each other, while the middle one walks in the alternate step. The walking of arachnids is represented by four men in file, the even-numbered ones walking in one step, while the odd-numbered ones walk in the alternate step.

PLANT-FEEDING HABITS OF PREDACEOUS BEETLES.—In a recent letter Mr. V. T. Chambers suggests that when Harpalus has been recorded as feeding on the seeds of *Ambrosia artemisiæfolia* it may have been feeding on the larvæ of *Gelechia ambrosiæella* which lives in those seeds. In reply we would remark that during the past year the question of the herbivorous habits of certain predaceous beetles has been settled beyond all peradventure. Notices of such habit, always considered exceptional among Carabidæ or ground-beetles, appear in a number of European works, and *Zabrus gibbus* more particularly has been known to be quite destructive to grain.[1] Coleopterists have always been inclined to doubt the accuracy of these charges, and those who believe in the unity of habit in a given genus or family are also slow to accept statements that indicate exceptional habits. In Bulletin 3 of the Illinois State Laboratory of Natural History, Mr. F. M. Webster, of Waterman, Ill., who had previously communicated his experience with certain species of Harpalus and Anisodactylus, charging them with being particularly fond of the unripe seeds of some grasses,[2] has given a more detailed account of the herbivorous inclination of various Carabidæ and even of one species of Coccinellidæ (*Megilla maculata* DeGeer). His observations and actual detection of the insects partaking of such vegetable food cannot longer be questioned, as they are fully confirmed and supported in a valuable paper in the same Bulletin by Prof. Forbes, Director of the Laboratory, who, by a series of microscopic examinations of the stomachs of various predaceous beetles, has confirmed the observations of Mr. Webster and proven beyond question that, while the habit of the Carabidæ is in the main carnivorous, yet a large number of the species feed upon either the spores of different fungi, the pollen of flowers, or the seeds of grasses and grains. Out of twenty-eight specimens, representing seventeen species belonging to the genera Galerita, Loxopeza, Calathus, Anisodactylus, Amara, Harpalus, Cratacanthus, Evarthrus, Pterostichus, Chlænius and Bradycellus, twenty specimens belonging to eleven species had eaten vegetable

[1] See Curtis' "Farm Insects," p. 388.
[2] *Am. Ent.*, III, p. 26.

matter of some sort. In fact about one-half the food of these twenty-eight specimens consisted of vegetation, one-third of it being derived from Cryptogamia and the rest from grasses and Compositæ.

Still more startling, however, are the results of his examinations of different Coccinellidæ or ladybirds. *Coccinella novem-notata*, *Brachyacantha ursina*, *Hippodamia convergens* and *Megilla maculata* were all found to be extremely fond of the spores of fungi and some of them of the pollen of different Compositæ, the last named species in addition to fungus spores and pollen grains (probably those of the common dandelion), was proven to feed also upon the anthers and pollen of grasses. We have long been suspicious that this species was almost as thoroughly a vegetable feeder as the well-known northern squash-beetle (*Epilachna borealis*), which was always supposed to be the only exception to the carnivorous habits of its family.

In July, 1874, we received a number of specimens of this Megilla from Mr. Geo. B. P. Taylor, of St. Inigoes, Md., who reported them as having done considerable injury to corn by eating holes in the blades, and specimens of blades that were riddled and perforated accompanied the beetles. We have on one or two occasions since endeavored to test the vegetable-feeding habit of this insect in confinement, but without success, though it freely partook of the eggs of other insects, while we have known it to feed indiscriminately on the eggs, larvæ and pupæ of *Lina scripta*, or the streaked cottonwood-beetle.

Mr. Chambers' note refers to a communication by Mr. Wm. Trelease in the *American Entomologist*,[1] who found the common *Harpalus caliginosus* engaged in eating the contents of the partly-grown seed of the Rag-weed (*Ambrosia artemisiæfolia*), which observations were confirmed by Prof. W. A. Buckhout,[2] of the State College, Center Co., Penn., who believed that he had in addition found this beetle feeding upon the pollen of the staminate flowers of the same plant.

In accordance with his general conclusions indicated in a notice in the present number "On some Interactions of Organisms," Prof. Forbes believes that this partial herbivorous habit among the predaceous beetles renders them more valuable to man than they would be if confined solely to animal food. To use his own language: "As a prudent sovereign finds it worth while to maintain a much larger fighting force than is necessary to the ordinary administration of his government, in order that he may have always a reserve of power with which to meet aspiring rebellion, so it is to the general advantage that carnivorous insects should abound in larger numbers than could find sustenance in the ordinary surplus of insect reproduction. They will then be prepared to

[1] Vol. III, p. 251.
[2] Ibid., p. 277.

concentrate an overwhelming attack upon any group of insects which becomes suddenly superabundant. It is evidently impossible, however, that this *reserve* of predaceous species should be maintained unless they could be supported, at least in part, upon food derived from other sources than the bodies of living animals."

NOTES ON PAPILIO[1] PHILENOR.—In the *Canadian Entomologist* for January, 1881, Mr. W. H. Edwards, of Coalburgh, W. Va., describes in full the egg and earlier stages of this interesting butterfly. Mr. Edwards remarks that the larva must undoubtedly feed upon some other plant than Aristolochia, since Mr. Mead found the female ovipositing on the leaves of a slender vine some years ago near Coalburg. In 1873 we made notes and descriptions of the egg and larval stages of this insect as found around St. Louis, where *Aristolochia serpentaria* and *A. sipho* are very

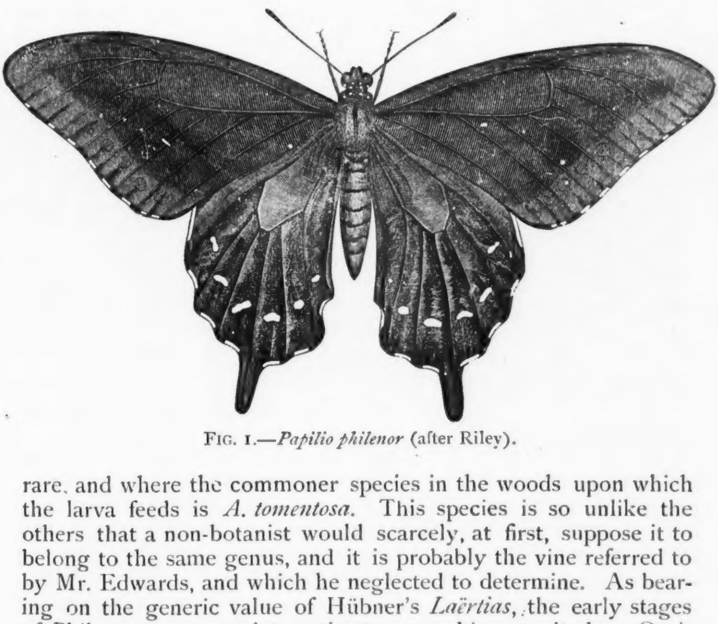

FIG. 1.—*Papilio philenor* (after Riley).

rare, and where the commoner species in the woods upon which the larva feeds is *A. tomentosa*. This species is so unlike the others that a non-botanist would scarcely, at first, suppose it to belong to the same genus, and it is probably the vine referred to by Mr. Edwards, and which he neglected to determine. As bearing on the generic value of Hübner's *Laërtias*, the early stages of Philenor are very interesting, approaching as it does Ornithoptera. The eggs show really no difference in sculpture from those of the other N. A. Papilios, the great difference in appearance being caused by a gummy coating. We found them during the month of July, on *Aristolochia tomentosa*, in patches of 16–20,

[1] *Laërtias* Hübn., as proposed by Scudder.

sometimes laid on the stem, sometimes on the upper side of the leaf, and we repeat here the brief description then made:

Sub spherical, having a flattened base. Diameter 1 mm. The surface perfectly smooth and, when fresh, the color yellowish; but as the embryo develops, the color deepens to reddish-brown. The general color, however, more or less ferruginous, owing to the surface being coated with a gummy substance of this color, which accumulates in little translucent lumps more or less irregular, but generally showing about a dozen rib-like series from the crown. Spines of the embryo as it matures visible through the shell. Shell so delicate that it collapses in drying if soaked in alcohol. The viscid covering is dissolved in alcohol or chloroform.

The newly hatched larva strongly recalls some larvæ of Acronycta and also the young of Attacus. But it is structurally very similar to the first larval stage of our other North American Papilios, so far as we have observed them, especially of Asterias, the tubercles being more pronounced, though it differs from the other species in being at first gregarious. This last difference in habit can, however, have no generic value whatever, as we find similar exceptions in other genera, *e.g.*, *Apatura herse* and *Sphinx catalpæ*, in which the eggs are laid in masses and the young are gregarious, though in the other species of either genus, the eggs are laid singly and the larvæ are solitary. Harris[1] gives an excellent account of the newly hatched larva, which he likens to the (presumably full grown) larva of Ornithoptera, and after giving an account of the larval changes, and of the pupa, expresses the opinion that the species is a connecting one between Papilio and Ornithoptera. The butterfly appears very early in the spring, and we have even known it to issue in mild weather in November at St. Louis. We further quote from our notes in regard to the newly-hatched larva:

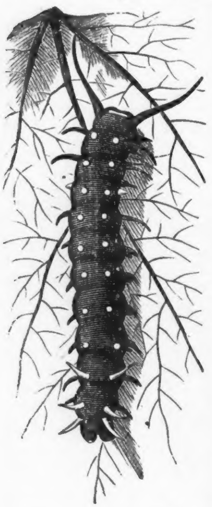

FIG. 2. Larva of *Papilio philenor* (after Riley).

Length 2.3 mm. Ferruginous-brown, the head and legs black. Eight rows of small, black, conical tubercles, each bearing a stiff black hair as long as or longer than the diameter of the body; four of the tubercles dorsal, and trapezoidal on all joints but second and third, the trapezoid reversed (*i. e.*, the anterior pair of tubercles wider apart than the posterior pair) on the black and polished cervical shield. There is, besides, a subventral and a ventral row of less conspicuous tubercles, generally concolorous with body and most prominent on the legless joints. On the second or third day the outer row of dorsal tubercles increase in size and become paler at base, and this is especially the case on prothoracic joint.

Mr. Edwards describes in detail the larval changes, and shows that there are only four molts instead of five, as he formerly supposed, which accords with our own notes. We gave some

[1] Correspondence, edited by S. H. Scudder, pp. 147, 273.
Harris's Companion, p. 247.

account of the insect in 1869,[1] from which the accompanying figures are taken.

Mr. Scudder communicated to us some years ago an interesting fact in reference to this species. It appears that the caterpillar, in 1840, ravaged the Aristolochias in the Botanic Garden at Cambridge,[2] and had never afterwards been seen in that vicinity until some plants of Aristolochia were taken from the Botanic Garden to Beverly, a few miles distant, when caterpillars appeared, in 1876, on the Beverly plants. Dr. Hagen recently notes their reappearance at Cambridge, presumably last year, as early as June.[3]

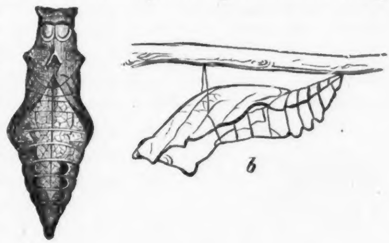

FIG. 3.—Chrysalis of *Papilio philenor* (after Riley).

We do not know of any records of this butterfly swarming, as several other species are known to do, but the following letter accompanied by specimens, addressed to us by the Rev. C. P. B. Martin, of Huntsville, Texas, March 5, 1874, shows that this species, too, may and does, in the Southern States, congregate in such swarms.

"I send you herein enclosed a butterfly, and though it is by no means a *rare* one, yet from the multitudinous swarms of it now flying about and literally *filling* the peach trees now in full bloom, I wish to know something more about it. I never saw so many butterflies of any one kind as there now are of this. The little yellow fellows that are seen in the summer around 'mud puddles' in the road, are few in comparison."—*C. V. Riley.*

ANATOMY OF THE MILKWEED BUTTERFLY.—Mr. Edward Burgess has lately published a paper on the structure of *Danais archippus*, which describes the anatomy of that butterfly with rare accuracy and clearness. Students of insect anatomy will especially appreciate this memoir, contained in the anniversary volume of the Boston Society of Natural History. It is one of the best entomological articles yet published, and makes us look forward eagerly to the appearance of other monographs upon other species of insects, which Mr. Burgess is understood to be engaged upon. The general figure (Pl. 1, Fig. 2) of the anatomy of Danais is particularly good, and ought to be copied into the text books. The author has elucidated many points, erroneously described or entirely overlooked by earlier writers. To him we owe the important discovery of a pharynx, or true sucking

[1] 2d Rep. Ins. Mo., pp. 116–118.
[2] See also Harris, *loc. cit.*, p. 147.
[3] *Can. Ent.*, Feb., 1881, p. 37.

stomach in the head, and of the extraordinary course of the aorta in the thorax, and the elucidation of the very complicated arrangement of the sexual organs. Even the gifted dissector, Newport, blundered badly in these matters. We can, therefore, better appreciate the skill requisite to avoid a repetition of these long accepted errors. The whole field of insect anatomy has been much neglected; we hope, therefore, that other investigators will add to the excellent contributions of Mr. Burgess.—*C. S. M.*

ENTOMOLOGICAL NOTES.—The second number of the new journal *Papilio*, organ of the New York Entomological Club, comes to us with an increased number of pages. There are many descriptions of new forms by Mr. Henry Edwards and Mr. Grote; among those by the latter, two species of Phycidæ injuriously affecting hickory, *Acrobasis caryæ* boring the twigs of *Carya porcina* and *Ac. angusella* boring the leaf-stem, presumably of the same species. If our memory serves us right, Edwardsia, the new generic name proposed by Mr. Neumœgen for the beautiful moth figured on the plate in the first number, is preoccupied for a genus of Actinozoa; and the name Oribates, proposed by Mr. Henry Edwards, in the second number, for a genus of small moths is preoccupied among the mites (Acarina).——In the Proceedings of the Boston Society of Natural History for January, 1880, Dr. Hagen describes a remarkably large species of Simulium (*S. pictipes*, n. sp.), the larvæ and pupæ of which were found in the rapids of the Au Sable river, Adirondack mountains. We have the larvæ and pupæ of what is presumably the same species, found by Messrs. Hubbard and Schwarz, in the rapids of the Michipicoten river, north shore of Lake Superior, and it is probable that this is the celebrated "black-fly" of that region. In the rapids of the Michipicoten the larvæ were found to have the peculiarity of floating in long single strings attached to each other by silken threads and the pupæ found in the quieter pools close by, resemble clusters of coral. Mr. Schwarz informs us that the Hudson Bay Company has furnished its employés with oil of tar as a protection against these flies, and he confirms from his own experience the fact that it is much better than pennyroyal or any other substance recommended for the purpose.——We learn from Mr. H. K. Morrison, of Morganton, N. C., that, after much delay, he has just received the insects collected by him last summer in California and Washington Territory.——At a recent meeting at Rochester, of the Western New York Horticultural Society, papers on insects affecting horticulture were read by Messrs. C. D. Zimmerman and Wm. Saunders.——Two bills have been presented before the California Legislature aiming to protect the careful farmer from insect pests bred upon the lands of shiftless neighbors.——Mr. Wm. B. Lazenby finds whale-oil soap the best specific for destroying cabbage-worms, and treats of other insecticides in the *American Rural Home* of February, 19th.

He has probably not tried our favorite remedy, Pyrethrum water. ——The *Pacific Rural Press* cites some successful experiments made by Mr. W. H. Gilmore, in the use of crude petroleum for destroying the scale insects on the bark of fruit trees.——Mr. A. E. Hodgson gives in the *Entomologists' Monthly Magazine* for February, a remarkable instance of vitality exhibited by the rhynchophorous genus Otiorhynchus, some specimens of *O. ambiguus* surviving after being left for over eight months in a poison bottle, consisting of a stopped glass jar with fresh laurel leaves which kill most insects in a few minutes. It is well known that other species of this genus have been kept in spirits of turpentine, in alcohol and in the cyanide bottle for days without being killed.——Dr. Theobald at a recent meeting of the Maryland Academy of Sciences, showed a beetle weighing two grains which moved 1320 times its own weight.——Dr. Horn publishes in the proceedings of the American Philosophical Society, a review of the species of Anisodactylus, and critical notes on the species of Selenophorus, giving synopses of all the species of these genera of ground-beetles found in the United States.——In the latest part of the *Stettiner Entomologische Zeitung* is a short article on the larvæ of Parnidæ, by C. W. Friedenreich of Blumenau, Brazil. ——Mr. A. D. Michael has read before the Linnean Society, an interesting paper on the life-history of the Gamasidæ, a family of mites which are very common parasites of beetles.——Professor T. J. Burrill writes in the *New York Tribune*, February 16th, regarding two cases in which plant-lice were found to be offensive in wells penetrated by roots of willow trees near Champaign, Ill.——In *Nature* for January 13, is an abstract of a paper read before the Linnean Society by Sir John Lubbock, relating to the habits of ants. An account is given of the care with which the ants keep in their nests over winter the eggs of plant-lice.

ANTHROPOLOGY.[1]

ANTHROPOLOGY IN FRANCE.—In connection with the Exposition at Paris in 1878, was held the "Congrès International des sciences anthropologiques." The superb collections of specimens illustrating every department of anthropology added very much to the interest and value of the papers read. These communications have now been collected and published in a volume bearing the name of the Congrès. Their titles will be found below:

D'Acy (E.)—Notes sur les patines des silex taillés des alluvions de Saint-Acheul, et sur l'ordre de leur superpositions, 234–237.

Ameghino, F.—L'homme préhistorique dans le bassin de la Plata, 341–350.

Bataillard, P.—Historique et préliminaires de la question de l'importation du bronze dans le nord et l'occident de l'Europe par les Tsiganes, 153–166.

Beddoe, J.—Sur quelques crânes d'un vieux cimetière de Bristol, 283–285.

Benedikt, M.—Sur les cervaux des Criminels, 141–148.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

Bordier—Rapport sur l'ethnologie de l'Asie orientale, de l'Afrique, et de l'Oceanie, 39–47.
Capellini, G.—Incisions sur des os de cétacés tertiaires, 224–234.
Cartailhac, E.—Rapport sur la paléoethnologie; période Robenhausienne ou de la pierre polie, 51–56.
Chil—Memoire sur l'origine des Guanches ou habitants primitifs des îles Canaries, 167–220.
Daleau, F.—Notice sur les stations préhistoriques de l'etang de Lacanau, arrondissement de Bordeaux (Gironde), 351–354.
Dupont, E.—Sur les Nutons, 124–126.
Girard de Rialle—Rapport sur l'ethnologie de l'Europe, de l'Asie occidentale, et de l'Amerique, 35–39.
Hovelacque, A.—Les races inférieur, 264–266.
Jacquinot, H. et P. Usquin—Le nécropole de Pougues les-Eaux (Niévre); derniers temps de l'age du bronze, 238–250.
Latteux—Procédé pour obtenir des coupes rigoreusement transversales du cheveu, 98–105.
Le Bon, G.—Recherches anatomiques et mathematiques sur les variations de volume du crâne, 72–75.
Maurel, E.—Etude anthropologique sur les immigrants indiens a la Guyane française, 75–98.
Mortillet, G. de—Découverte de l'Amerique aux temps préhistoriques, 267–273.
Pagliani, L.—Etudes anthropométriques, 62–72.
Richard—Sur des découvertes de silex taillés dans le Sahara africain, en Egypte et en Palestine, au tombeau de Josué, etc., 278–282.
Royer, Mme. C.—Des rapports des proportions du crâne avec celles du corps, et des caractères correlatifs et évolutifs en taxonomie humaine, 105–119.
———Mémoire sur l'origine des Aryas et leurs migrations, 304–333.
Schmidt, V. — De l'age de bronze en Europe et notamment en Scandinavie, 285–288.
Souché—Une Sépulture de l'epoque Robenhausienne, ou de la pierre polie, a Pamproux (Deux Levres), 336–340.
Thomas, P.—Recherches sur les sepultures anciennes des environs D'Aïn-el-Bey (near Constantine, Algiers), 358–385.
Topinard, P.—De l'unification des methodes craniométriques et en particulier de cubage des crânes et du plan alveolo-condylien, 135–144.
———Rapport sur l'anthropologie, anatomique, biologique, et pathologique, 29–35.
Ujfalvy, de C.-E.—Quelques observations sommaires sur les races en Asie Centrale, 126–135.
Zabarowski, S.—Des monuments prehistoriques de la basse vistule, 259–264.
Zawisza J.—Sur la caverne du mammouth (en Pologne), 220–222.
Zeballos, E. S.—Note sur un tumulus prehistorique de Buenos-Ayres, 148–153.

THE HISTORY OF RELIGION.—It is well nigh impossible to keep pace with the multiplication of anthropological journals. We have to record, among the number a new aspirant, entitled " Revue de l'Historie des Religions, publiée sous la direction de M. Maurice Vernes avec le concours de MM. A. Barth, A. Bouche-Leclercq, P. Decharme, S. Guyard, G. Maspero, and C. P. Tiele (of Leyden). Première année, Tome II, No. 5, Septembre, Octobre. Paris, Ernest Leroux, Editeur, 1880 (Annales due Musée Guimet). The Review is purely historical, excluding everything of a polemic or dogmatic character. A very excellent bibliography is appended to each member.

GERMAN ANTHROPOLOGY.—The third of the series of bibliographical lists, in the *Archiv für Anthropologie* is a quarto brochure of 136 pages, by Frederick Ratzel upon ethnography and travels (Völkerkunde und Reisen), covering a period from July, 1878, to December, 1879. Dr. Emil Schmidt, of Essen, in Rhenish Prussia, is the editor of the *Archiv* in charge of matters relating to our country, The readers of the NATURALIST who have published papers on anthropology would do well to send a copy of each to Dr. Schmidt.

THE TRENTON GRAVELS AND EARLY MAN.—Mr. Henry Carville Lewis sends us a pamphlet reprint from the Proceedings of the Acad. of Nat. Sciences of Philad., entitled "The Trenton Gravel and its Relation to the Antiquity of Man." After going over the ground carefully as a geologist, the author comes to the following conclusions:

1. That the Trenton gravel, the only gravel in which implements occur, is a true river deposit of post-glacial age, and the most recent of the gravels in the Delaware valley.

2. That the palæoliths found in it really belong to and are a part of the gravel, and that they indicate the existence of man in a rude state at a time when the flooded river flowed on top of this gravel.

3. That the data obtained do not necessarily prove, geologically considered, an extreme antiquity of man in Eastern America.

MICA VEINS.—Mr. W. C. Kerr, State Geologist, Raleigh, North Carolina, read a paper before the American Institute of Mining Engineers, at the New York meeting, February, 1881, on the mica veins of North Carolina. The source of supply for various aboriginal products has become an important branch of archæological study. The result of the very latest investigations prove that copper and other substances were not transported so far as the first students of ancient commerce supposed. This does not vitiate their labors, but rather points to the wider diffusion of each separate industry than was suspected a few years ago.

THE AMERICAN ANTIQUARIAN.—The October number of this quarterly contains the following:

The emblematic mounds and the totem system of the Indian tribes. By Rev. S. D. Peet.
Relics of aboriginal art and their ethnological value. By Col. Charles Whittlesey.
Ancient quartz workers. By Miss Frances E. Babbitt.
The Rabbit and the Grasshopper: an Otoe myth. By Rev. J. O. Dorsey.
On the alabaster quarries and flint-works found in Wyandotte cave. By Rev. H. C. Hovey.
Aboriginal use of copper in war and in peace. Prof. J. D. Butler.
Correspondence.—The Chemakum Language. Rock-made Effigies. A curious prehistoric relic. Mounds in Kansas. Another nest of arrow-flints. Stone image found in gravel. Indian village sites.
Editorial Notes.—Gleanings from Magazines.—Book Reviews.

This number commences Vol. III, and is not behind its predecessors in the variety and value of its material.

THE BRONZE AGE IN GERMANY.—Our readers will remember the superb volume of M. Chantre upon the Bronze age. We have to draw attention to a second work that has just fallen into our hands, though bearing the imprint of 1878. It is entitled, "Die Bronzeschwerter des Königlichen Museums zu Berlin. Herausgegeben im Auftrage der Generalverwaltung, durch A. Bastian und A. Voss. Berlin, Weidmannsche Buchhandlung, 1878." This elegant quarto contains XVI, 79 pages of text, and 16 plates, in which are 281 photolithographic figures. Although the title is "bronze-swords," the drawings and descriptions include arm-ornaments, axes, buckles, plates, amber, celts, batons, daggers, iron, ivory, leather, fibulæ, vessels, gold, girdle, neck-ornaments, resin, wood, horn, clappers, boxes, spear-points, knives, needles, chapes, palstave, beads, arrow-points, tweezers, sconces, bucklers, keys, sword-hilts, spirals, pottery, urns and tongs. The localities from which the objects come are the different States of the German Empire, Denmark, Sweden, Austro-Hungary, Italy, Greece, Turkey and Egypt.

To each plate a chapter is devoted, in which the separate objects are described minutely, and the catalogue number and museum indicated.

In the introduction, Professor Bastian gives an excellent résumé of studies on the Bronze-age with copious references to authorities. On the whole, this is one of the most comprehensive and thorough archæological monographs we have seen for many a day.

ANTHROPOLOGY IN GREAT BRITAIN.—The August number of the Journal of the Anthropological Institute commences Vol. x. The original communications cover a variety of subjects, all of which are of general interest. Their titles are as follows:

On the Central South African Tribes from the south coast to the Zambesi. By Dr. Emil Holub.

Notes on the Western Regions. Translated from the "Tsĕĕn Han Shoo," Book 96, Part 1. By A. Wylie, Esq.

On the origin of the plough and the wheel carriage. By E. B. Tylor.

Visualized numerals. By Francis Galton.

On Nicobarese ideographs. By V. Ball.

Notes on the Polynesian races. By C. Staniland Wake.

The paper of Dr. Holub is a description of personal adventures among the Bushmen, Hottentot, and Banthu tribes, and is illustrated with plates from his work, "Seven Years in South Africa," published by Sampson Low and Marston.

The Notes on the western regions are translations from ancient Chinese records of references to Asiatic nations lying to the west of them.

Mr. Tylor's communication on the plough and the wheel carriage has already appeared in *Nature*, as well as Mr. Galton's upon visualized numerals.

The paper which will be most carefully and widely read, per-

haps, is that of Mr. Wake. Therein the author proposes "to show, first, that the Polynesian islanders must be described rather as a bearded than a non-bearded race, and, second, that, as a rule, they are well acquainted with the use of the bow and arrow." He also proposes to substitute for *Sawaiori*, of Whitmee, *Malayo-Polynesians*, of Humboldt, or *Mahori*, of Ranken, the word Rănăkā, it being the universal expression for "man" throughout the Polynesian groups.

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GEOLOGY AND PALÆONTOLOGY.

MAMMALIA OF THE LOWER EOCENE BEDS.—As stated in my report to Lieut. Wheeler in 1877, no vertebrate remains have been found in the Puerco beds, which underly the Wasatch in New Mexico, up to the present time. It was therefore uncertain whether they form the top of the Cretaceous or the bottom of the Tertiary series. I have recently obtained evidence of the existence of *Mammalia* and turtles in them, so that their position is probably in the Tertiary division, as already suspected by Dr. Endlich and myself. Two species of flesh-eaters recently received from beds that may prove to belong to the Puerco group, do not belong to genera hitherto known from the Wasatch. The one which I first describe is of considerable interest as representing a very primitive type of carnivorous dentition.

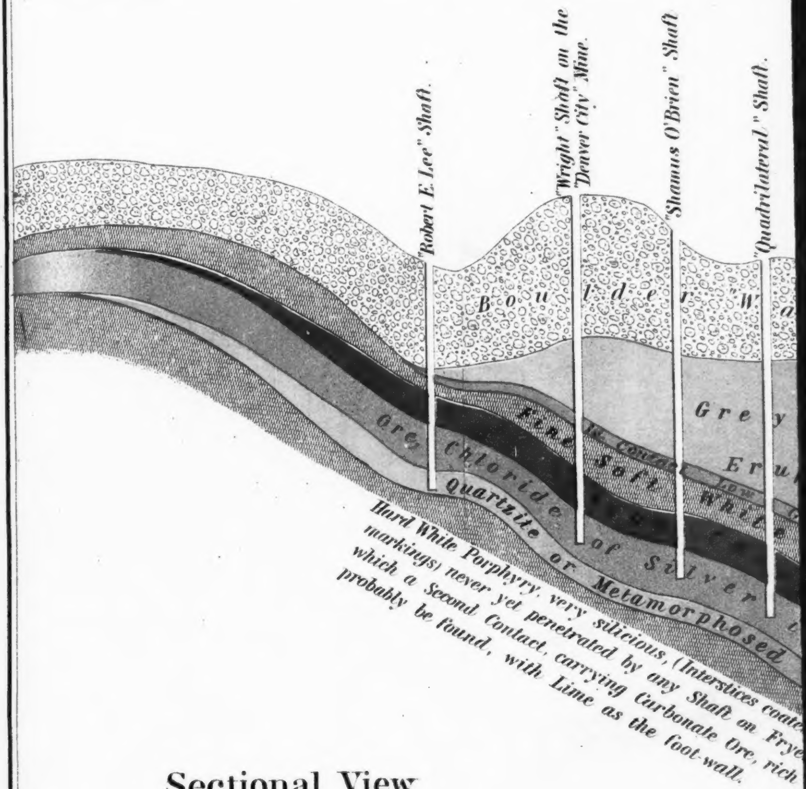
Periptychus carinidens, gen. et. sp. nov. Creodontium. *Char. Gen.* No distinct sectorial teeth, the first and second true inferior molars similar. They support a principal median cusp, a broad heel and a prominent anterior cingulum. The heel is more or less divided into tubercles; the anterior cingulum is on the inner side, and represents the anterior cusp of a sectorial tooth. On the inner side of the principal cusp a cingulum rises, forming a flat internal tubercle. Last molar not smaller than the others; premolars unknown.

This genus belongs to the *Amblyctonidæ* with *Amblyctonus* and *Palæonyctis.* It differs from both in the rudimental character of the anterior cusp, and from the former, in the presence of the internal tubercle. In *Mesonyx* the heel has a median cutting edge. *Char. Specif.* Parts of both mandibular rami and the shaft of a humerus represent this species. They indicate an animal of the size of the red fox, but much more robust. The mandibular ramus is rather shallow and thick, and the molars are not large. The heel of the penultimate supports three tubercles, of which the external is the largest. The anterior cingulum supports a small cusp, and then rises to the internal tubercle, which is compressed. The sides of all the cusps are marked with distinct, well separated, vertical ridges. Each extremity of the internal cusp is connected with the principal cusp by a ridge. The first true molar has fewer cusps. Those of the heel are scarcely distinct, and form a border which rises prominently into the flat internal tubercle, which forms a narrow longitudinal blade. The anterior cingulum has no cusp and does not rise into the inner tubercle. The principal cusp has a strong entering groove next the inner tubercle. Length of crown first molar, .0115; width of do., .006; elevation of do., .006. Length of second molar, .011; width of do., .007; elevation of do , .0065. Depth of ramus at do., .020. The species is a good deal smaller than the *Amblyctonus sinosus.*

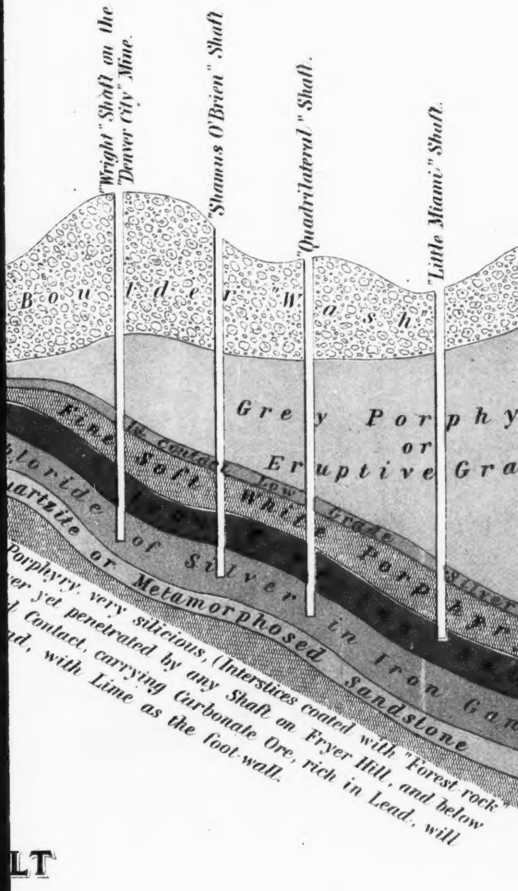
Deltatherium fundaminis, gen. et sp. nov. *Char. Gen.* Fam. *Leptictidæ*, agreeing with *Ictops* and *Mesodectes* in possessing an

internal tubercle of the third superior premolar, but differing from both in having but one external cusp of the fourth superior premolar. *Char. Specif.* Represented by the dentition of both maxillary bones minus the canines. The second premolar is convex on the inner face. The base of the third is a nearly equilateral triangle. The bases of the true molars are triangles, with the bases external. The internal angle supports an acute cusp, and has a posterior basal cingulum, which is very strong in the last three molars. The two external cusps of the first and second molars are situated well within the base, which is folded into a strong cingulum. This cingulum develops strong anterior and posterior angles. This is the largest species of the family yet discovered. Extent of series of last six molars, m. .045; of true molars, .026; diameters of fourth premolar, anteroposterior, .0074; transverse, .0076; do. of second true molar, anteroposterior, .0087; transverse, .0100. This species was a fourth larger than the common opossum, and very much resembles it in dental characters. —*E. D. Cope.*

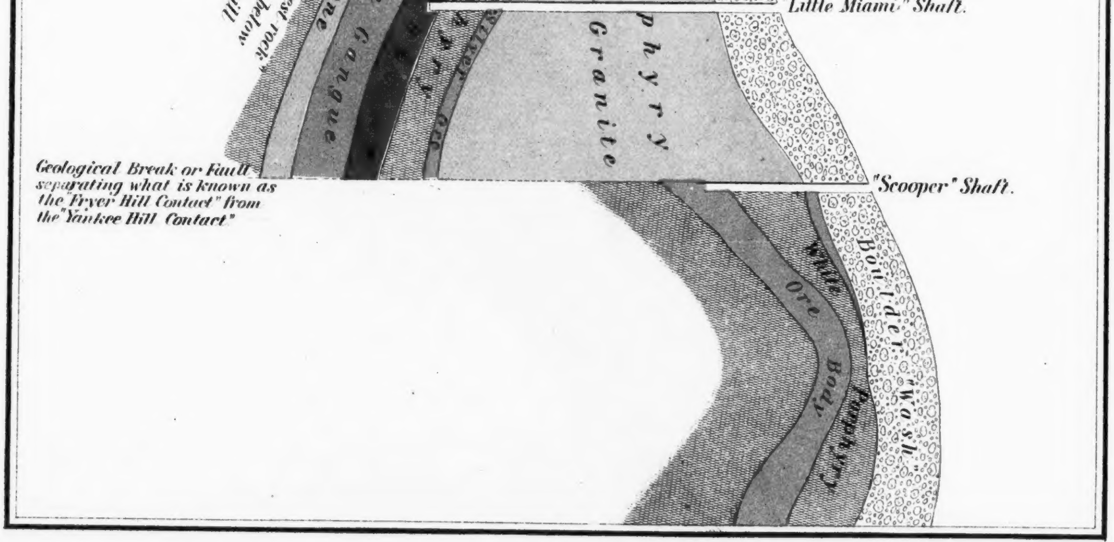
THE FAULT OF THE YANKEE HILL SILVER DEPOSIT OF LEADVILLE, COLORADO.—The formation on the surface of Fryer Hill and adjoining hills east of Leadville, Colorado, consists of an uncommonly deep "wash," of boulders embedded in earth, varying from 150 to 175 feet in depth. Immediately under this wash we encounter a dark gray eruptive or porphyritic granite. This porphyritic granite varies from twenty feet, in the Denver City discovery shaft, on the west, to nearly if not quite four hundred feet in thickness in some of the claims adjoining the property to the east; and the dip is quite uniformly north north-east, although at the Denver City discovery shaft, a local wave causes the ore body to dip slightly to the west. Under this gray porphyritic granite a low grade deposit has invariably been encountered by all of the shafts which have so far penetrated through it, which consists principally of a clayey mass varying from five to twenty feet in thickness, with small bodies and stringers of low grade silver ore interspersed through it. So far I have not learned of any ore being found in this deposit which has assayed over five to forty ounces, although it has been penetrated at nearly a dozen different points in this section, viz: in the Denver City discovery shaft, in the Shamus O'Brien, in the Little Miami, the El Paso, the Tip Top, the Little Sliver, the Compromise and other shafts which I will not occupy space in enumerating. To the west of a line drawn through the Little Sliver and Denver City discovery shafts the main contact comes so much nearer the surface that these overlying formations have undoubtedly been scored off by glacial action. This is plainly evident at points in the Lee, the Little Pittsburgh and the New Discovery claims, where the excoriation has cut down clear through the white porphyry and iron and left the boulder wash lying upon the silver-bearing iron itself.



Sectional View
of
THE YANKEE HILL FAULT


"Wright" Shaft on the "Denver City" Mine.
"Shamus O'Brien" Shaft
"Quadrilateral" Shaft.
"Little Miami" Shaft.
Boulder "Wash"
Grey Porphy
or
Eruptive Gra
Fine Soft White Porphyr
...le contact Low Grade Silver
...hloride of Silver in Iron Gan
...artzite or Metamorphosed Sandstone
Porphyry, very silicious, (Interstices coated with "Forest-rock" ...
...er yet penetrated by any Shaft on Fryer Hill, and below
...d Contact, carrying Carbonate Ore, rich in Lead, will
...ad, with Lime as the foot-wall.

LT


"Little Miami" Shaft.
"Scooper" Shaft.
Boulder "Wash"
Porphyry
White Ore Body
phyry
Granite
Silver Ore
Gangue
Geological Break or Fault separating what is known as the "Fryer Hill Contact" from the "Yankee Hill Contact"

Under the low grade ore bed just described, comes in a soft, white feldspathic porphyry, which in this vicinity usually averages about fifty feet thick, although I know of a point about one mile east, where it was found to be over two hundred feet thick. This white porphyry lies immediately above the iron with which and in which the ore bodies are found. A study of the accompanying diagrams will aid in gaining a clear idea of the lay of the different formations.

Enough development has already been accomplished at numerous points to prove that the ore body uncovered in the Denver City discovery shaft belongs to the Fryer hill deposit, and it is equally certain that such ore deposit with a few local waves, and also possible slight faults, continues in a practically unbroken dip from the extreme western workings of the Chrysolite group, in an easterly direction for a distance of over four thousand feet, to the well defined geological break or fault (of at least four hundred feet slip) which gives rise to what is commonly known as the "Yankee Hill Contact." This break corresponds very nearly to the fault which separates Carbonate hill from Iron hill, and which fault is better understood, as the foot wall of the ore bodies on those hills is a heavy ledge of limestone undoubtedly in place; whereas the foot wall of the present Fryer hill bodies is generally a layer of true quartzite, or metamorphosed sandstone, which in turn lies upon a hard white, silicious porphyry, similar to that which overlies the whole of the Carbonate and Iron hill ore bodies. In places this quartzite is wanting, in which case the mineral lies upon the hard white porphyry. This porphyry has not yet been passed through by any of the shafts so far sunk upon Fryer hill, and what underlies it is still an unsolved problem. I will venture to predict, however, that other and possibly larger ore bodies than those now being worked are yet to be found in place, with lime as a foot wall, under this porphyry; and such bodies will probably also be richer in lead, if not in silver, as is the case with the ore bodies found on lime in other portions of the camp. This, at least, is a matter which should be proved by sinking one or more shafts on Fryer hill to the granite bed rock.—*W. G. Shedd.*

FILHOL ON PROÆLURUS.—Mr. H. Filhol has recently published a monograph on this genus in the Society of Physical and Natural Sciences of Toulouse, illustrated by five plates. *Proælurus* was discovered by Mr. Filhol, and the remains of three species occur in the upper Eocene of Quercy, and the lower Miocene of St. Gerand le Puy. The discovery, at the latter locality, of a nearly perfect skeleton of the *P. lemanensis*, gave rise to the present memoir. Mr. Filhol shows that in this genus, the foramina of the base of the skull characteristic of the *Nimravidæ* and *Cryptoproctidæ*, are all present. These are the two alisphenoids, the postglenoid, and the distinct carotid and condyloid. These foramina

were all assigned to *Procœlurus* by inference, prior to their discovery, in the article on the extinct cats of America in the December, 1880, number of the NATURALIST, and the genus was therefore referred to the *Nimravidæ*. Mr. Filhol, however, shows that there are five toes on all the feet instead of five and four, so that *Procœlurus* must be referred to the *Cryptoproctidæ*. A detailed comparison gives the resemblances and differences between the *P. lemanensis*, and the *C. ferox*. In this memoir we have another interesting contribution to the history of the types of the Eocene fauna whose representatives yet remain in the southern hemisphere.

THE CLASSIFICATION OF THE PERISSODACTYLA.—In the forthcoming Report of the U. S. Geological Survey of the Territories of Dr. Hayden, the following arrangement is given by Professor Cope.

I. Anterior exterior crescent of superior molars shortened and connected with an anterior basal lobe; inferior molars with cross-crests; premolars different from molars.

1. Toes 4—3.. *Lophiodontidæ*.
2. Toes 3—3.. *Triplopodidæ*.

II. Anterior exterior crescent of superior molars like div. I; inferior molars with cross-crests; superior molars and premolars alike, with cross-crests.

3. Mastoid bone forming part of the external wall of the skull; no postcotyloid tuberosity of the mandible; neck elongate.............. *Hyracodontidæ*.
4. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; a postcotyloid tuberosity of the mandible; neck short.. *Rhinocerontidæ*.

III. Exterior crescentoid crests of superior molars subequal; inferior molars with cross-crests.

5. Superior molars and premolars alike and with cross-crests........ *Tapiridæ*.

IV. The external crescentoid crests of the superior molars subequal; inferior molars with crescents.

A. Premolars different from molars; the superior with only one internal cusp.

6. Toes 4—3.. *Chalicotheriidæ*.

AA. Premolars like molars, with two internal lobes above.

7. Toes with digits 4—3.. *Palæotheriidæ*.
8. Toes with digits 3—3.. *Anchitheriidæ*.
9. Toes with digits 1—1.. *Equidæ*,

GEOLOGICAL NEWS.—Professor Huxley evidently believes in American palæontology. He is still lecturing on our fossil horses, concerning which he apparently has information not generally accessible to American palæontologists. He has expressed the opinion that the primitive mammalia were five-toed, after it had been announced in this country, and he has recently discovered that the *Insectivora* represent a primitive type of mammalia. This view was proposed here six years ago, long enough ago for Professor Huxley to have forgotten where the idea originated.——Professor Wilder in *Science*, suggests that the large sacral neural cavity found by Marsh in *Hypsirhophus (Stegosaurus)*, was not filled by nervous matter. This view has doubtless occurred to most per-

sons familiar with the anatomy of the *Batrachia* and *Reptilia.* ——Professor T. S. Hunt has recently published an account of the mineral products of the Hocking valley, Ohio.——Mr. J. W. Hulke, in the London Geological Society Journal for August, 1880, describes in detail the new *Iguanodon prestvichii* from the Kimmeridge clay from near Oxford, England. He shows that in this genus, the second row of tarsal bones is articulated with the metatarsals, as in birds.

GEOGRAPHY AND TRAVELS.[1]

VOYAGES IN BEHRING STRAIT IN 1880.—The U. S. revenue steamer *Corwin*, Captain C. L. Hooper, was sent early in the summer of 1880, to the Strait of Behring, to ascertain the fate of the two whaling vessels lost in the ice in the autumn of 1879, and also to endeavor to communicate with the exploring steamer *Jeannette.* She made three trips into the Arctic Ocean through Behring Strait. Herald Island was sighted several times and found to be surrounded by ice. The *Corwin* approached to within seven miles of the land, but was stopped by ice from twelve to forty feet thick. Captain Hooper thinks the ice around the island was old; that for two or three years at a time it does not leave the island free, and rarely breaks up between Herald Island and Wrangell Land. The perpendicular sides of Herald Island must render it inaccessible to all but the birds of the air, and no signs of life were visible.

The *Corwin* reached Point Barrow on August 25th. "On the 11th of September," Captain Hooper's report continues, "we saw the high hills of Wrangell Land, bearing west one-quarter east (true). We ran in toward it until we came to the solid pack, the ice having the same general appearance as that we had previously encountered in the vicinity of Herald Island, except in being covered with newly fallen snow, and being, consequently, white. We judged the land to be about twenty-five miles away. The highest hills, which seemed to be more distant, were covered with snow; others were partly covered, and still lower ones were almost entirely bare. The sight of this land repaid us to a certain extent for our disappointment in not finding Herald Island clear of ice as we had hoped to do in order that we might run lines of soundings and make a plan of the island. That part of Wrangell Land which we saw covered an arc of the horizon of about 50°—from N. W. ¼ N. to W. ¼ S. (true)—and was distant from twenty-five miles on the former, bearing to thirty-five or forty miles on the latter. On the south were three mountains, probably 3000 feet high, entirely covered with snow, the central one presenting a conical appearance, and the others showing rounded tops. To the northward of these mountains was a chain of rounded hills, those near the sea being lower and nearly free from snow, while the

[1] Edited by ELLIS H. YARNALL, Philadelphia.

back hills, which probably reach an elevation of 2000 feet, were quite white. To the north of the northern bearing given, the land ends entirely or becomes very low. The atmosphere was very clear, and we could easily have seen any land above the horizon within a distance of sixty or seventy miles, but none could be seen from the masthead."

Captain Hooper considers it doubtful if Wrangell Land is ever free from ice. The immense body of warm water which is constantly passing through Behring Strait into the Arctic is carried to the east along the shore of the American Continent, and does not pass within two hundred and fifty miles of Wrangell Land. "I believe, however that it is possible, at times, for a strong vessel, properly equipped and fitted, to work her way in shore far enough to reach a safe harbor among the grounded ice within easy traveling distance of the land, where she could remain in safety, and exploring parties be sent out to examine the land. I am of the opinion that Wrangell Land is a large island, possibly one of the chain that passes entirely through the polar regions to Greenland. That there is other land to the northward there can be no doubt.

"Captain Keenan, then commanding the bark *James Allen*, reports having seen land to the northward of Harrison's Bay, a few degrees east of Point Barrow. He was boiling out, and stood north under easy sail, during thick weather, eighty or ninety miles. When the fog lifted high land was visible to the northward, a long distance away but perfectly distinct. Large numbers of geese and other aquatic birds pass Point Barrow going north in the spring, and return in August and September with their young. As it is well known that these birds breed only on land, this fact alone must be regarded as proof positive of the existence of land in the north. Another reason for supposing that there is either a continent or a chain of islands passing the polar regions, is the fact that notwithstanding the vast amount of heat diffused by the warm current passing through Behring Straits, the icy barrier is from $6\frac{1}{2}°$ to $8°$ further south on this side than on the Greenland side of the Arctic Ocean, where the temperature is much lower. The Tchukches have a number of legends in regard to some of these people having left the mainland and crossed over the ice to a 'great land' further north; and also of herds of reindeer having crossed over from the north. There may or may not be foundation for these legends.

"To attain a high latitude with a vessel in this part of the Arctic is impossible. The whalers follow the ice-pack very closely between Herald Island and Point Barrow, and never have been able to reach the seventy-fourth degree of latitude as yet, while only one or two claim to have been as far north as $73°$. In the Greenland seas, on the contrary, it is no uncommon thing for whalers to reach the seventy-eighth degree, or even higher.

From what I can learn from the accounts of those who have

traveled in other parts of the Arctic, and from my own observations, I believe that nowhere else within the Arctic Circle does ice remain permanently so far south as between Wrangell Land and Point Barrow." [1]

No traces of the missing whalers were found and there can be no doubt that they and their crews perished in the pack.

Mr. W. H. Dall, of the U. S. Coast Survey, continued his explorations in Alaska and the northern coast of America during the past season, being accompanied by Dr. Bean, who has also been making the zoölogical collections in this region for a number of summers, for the U. S. Fish Commission.

After visiting the inland waters of British Columbia and Alaska, they arrived at Sitka and proceeded thence along the coast to Cook's Inlet, westward to Unalaskha, and northward through Behring Strait along the American coast to the Seahorse Islands, not very far west of Point Barrow, where the ice barred their way. Forty-two stations were occupied during the season for astronomical, magnetic, meteorological and hydrographical observations.

A hydrothermal section of Behring Strait was made, which Mr. Dall states confirms his previous suspicions that there is no southerly Polar current through these straits, and that the existing currents are dependent chiefly on the tides. The warm northerly current through the straits is chiefly derived from the shallow sounds and large rivers of the adjacent American coast, and is warmer than any water found south of St. Lawrence Island, at the southern entrance to the strait.[2]

The boundary line between Russia and the United States is found to pass between the Diomede Islands, as stated in the treaty. An immense "dead" glacier was observed on the northwest shore of Yakutat Bay, near the foot of Mount St. Elias. The feeders of this great ice-field, which covers perhaps seventy-five square miles, are so shrunken by the more milder climate, that the mass now lies as a great plain or table-land, without motion, and covered with detritus, which preserves it from the heat of the sun. A careful examination was also made of another most remarkable ice phenomenon in Kotzebue Sound, visited by Kotzebue, Beechey, and the officers of the *Herald*, whose

[1] It may here be noted that the general experience of navigators north of Behring Strait has been that the early part of the summer season is the only time Herald Island or Wrangell Land can be approached. The action of the warm current from the Pacific is quickly felt on the ice fields south of latitude 71°, and west of longitude 173°, so that a barrier of rotten ice brought by the southerly and easterly drifts of the opposing polar current that flows along the eastern side of Wrangell Land, stretches from Cape Serdze on the Asiatic coast to Cape Krusenstern on the Alaska shore. If this barrier is penetrated the sea is found to be comparatively free of ice until the limit of the great northern ice field is reached. In the latter part of July vessels are able to approach very near to Herald Island, but later the advance of the great northern pack causes it, as well as Wrangell Land, to be unapproachable.—*Editor.*

[2] These results are surprising; it having heretofore been generally believed that a considerable portion of the great equatorial current of the Pacific, the Kuro-Sivo, passed through the strait, and they invite the careful examination of geographers.—*Editor.*

wooden record, standing since 1826, was found in good preservation on Chamisso Island. This consists of a mountain of pure ice, covered with a non-conducting layer of moss, vegetable matter and clay, of the period when the wild horse, buffalo and mammoth, frequented this region. Their bones are abundant and have been figured by Seeman, in the zōology of the *Herald*. The ice attains an elevation much beyond any hills or rock-formation visible from its summit, and is interstratified like a rock with the clays, etc. It is pure, except on the surface, has no glacial débris about it, and is devoid of motion. The cliffs rise at the sea front to perhaps one hundred feet, and the hill of ice of which these cliffs form the face, attains six hundred or eight hundred feet, a few miles inland, entirely overlooking all the rock-formations of the vicinity. Mr. Dall considers it impracticable to refer it to glacial action, properly so called. It extends north to Point Barrow, and East to Return Reef on the northern coast, but is not continuous, and is absent in the rocky, elevated parts, as for instance, about Cape Lisburne.

The zoölogical collections made during the past season include several birds and many fishes new to the region, as well as a smaller number probably new to science. Ethnological material was largely obtained, and it was remarked that the proper name of the people on the Asiatic side, described by Nordenskiöld and his companions, and previously by Hooper and Mr. Dall, is Yū′-it, a corruption or shortening of In-ñū-it (Eskimo), of which they merely form one tribe. They are totally distinct in language, race and manners from the so-called Reindeer Tchukches (Tsau′-yū-at), who are a mere tribe of the Korak nation.

Mr. Dall maintains that these Asiatic Eskimo are comparatively modern immigrants from America. The change of population is constantly going on; only last summer a new colony from Behring Strait settled at Cape Olutorsk, and more will go this year to join them. Internal hostilities and the want of food are the causes. Two winters ago several hundred of American Eskimo perished from starvation on St. Lawrence Island. The destruction of walrus by the whale ships during the scarcity of whales has had much to do with it; and the trading of liquor from the Sandwich Islands, keeping the people drunk when they should be laying up a winter store, is another.

LAKE TANGANYIKA.—Mr. E. C. Hore writes from Ujiji to the Royal Geographical Society[1] regarding the still unexplained phenomenon of the long-continued rise of the waters of this lake, and the reopening of the Lukuga outlet, which he was the first to witness two years ago, that the reports at Ujiji "go to show that when Cameron was here a marked rising of the lake waters had already been observed, and that it continued from that time up to about two years ago, when the surface was eight feet higher than in Cameron's time. From that date (*i. e.* two years ago), I

[1] Proceedings R. G. S., January, 1881, p. 41.

have observed that the waters are gradually retiring, and this at a very regular rate, except during the rains (when, however, there is no rise). Three months ago the Arabs agreed in telling me, '*Now* the lake is the same as when Cameron was here.' The partly submerged palm-tree on which I had fixed a water-gauge, was then just left dry, and the Arabs told me that Cameron used this tree as a target and that it was then just at the water's edge. Now, all the observations and the reports I hear lead me to believe that the lake has been gradually rising for years, and that it rose until it burst open the Lukuga obstruction, first oozing through in small quantities as when seen by Cameron. That the waters should now rush through the Lukuga instead of gently overflowing is probably due to the first burst having eroded a deeper channel; for, according to the geological nature of the Lukuga gap, so will the waters cut a deeper and deeper chasm, or eventually find a permanent level and gently flow over a rocky sill. I cannot think that there could have been, just before the late bursting of the Lukuga, any more than a mere trickle of water through the obstruction there, and that of periodical occurrence, and of but small amount as a drainage of the lake. But what is still unaccounted for is this: before the time of Cameron's visit this periodical rising must have been infinitesimal, if any, compared with that of the few years immediately preceding the bursting of the Lukuga, or we must do away with the ancient character of the lake. I am convinced that the lake never (or, at any rate, for very many years), was at such a height as it was two years ago. This is quite apart from any geological evidence of a different state of things in remote ages. And I cannot believe that the lake has always been rising at this rate. Now, how is it that this enormous quantity of water could rise so quickly in spite of that evaporation which has (as is supposed) been sufficient for ages to maintain it almost at a level. A succession of extraordinary rainy seasons, of which we have no evidence, would not account for it. I can bear testimony to an enormous *evaporation*, but how is it that the waters suddenly gained upon the evaporation as they had never done before?"

Mr. Hore seems disposed to connect the changes of water-level with earthquake movements. Earthquakes were occurring at the time of writing (September 13th, 1880). One of the Arabs stated that some years previous an extraordinary disturbance of the lake waters occurred; a long line of broken water being seen, like a reef, bubbling and reeking with steam. The next morning all was tranquil, but the shore was strewn with masses of a substance resembling bitumen, specimens of which Mr. Hore had secured to bring with him to England. An excellent map of the southern end of the lake has been made by Mr. Hore. Latitude by stars N. and S. was observed at twelve different places, and the coast line between them laid down by compass bearings.

MICROSCOPY.[1]

A New Fine Adjustment.—Mr. Ernst Gundlach, of Rochester, has introduced a device by means of which an extremely slow, fine adjustment can be obtained in addition to the ordinary coarse screw movement. It is described as follows:

In working high powers, microscopists have felt the need of a finer adjustment than the ordinary micrometer-screw, which cannot be made much finer and still be durable enough. This need is now supplied by the combination of two screws which give a resultant motion equal to the difference in the threads employed. One of these screws is a little coarser than the ordinary micrometer screw, and may be used alone as a fine adjustment, and a change can be made instantly from this to the finer motion. Either is given by one milled head located in the usual position of the fine adjustment screw-head on Gundlach's microscopes, and the change is made by turning a smaller clamping screw having its head over the former. By tightening the clamping screw, the adjustment is in order for the work of the combination; by loosening, for that of the coarser screw only. As the thread of this is a little coarser than the ordinary micrometer screw, it alone gives a better motion for medium powers than the fine adjustment in common use, a second advantage of the invention.

New Method of Dry Mounting.—Mr. Frank French has contributed to the Postal Microscopical Club, a slide mounted in a style which promises to be useful for certain kinds of opaque objects which will bear occasional exposure to the dust and moisture of the air, and which are best viewed without the intervention of a cover-glass. The slip is composed of cardboard cut to 3 × 1 inches, the required thickness in each case being attained by building up a sufficient number of thicknesses, gummed together. The centers are punched out as from the paper covers for glass slips; and the object is fastened at the bottom of the cell thus formed, either upon mica fastened at the bottom of the cell or upon a bottom card not punched like the rest. The object is covered by a rectangular brass sliding plate below the upper card, the card next below being cut away to receive it and to allow it room to slide entirely away from sight when desired. A pin head is riveted and soldered into this brass plate, and projects through the upper card, appearing near the right end of the finished mount, through a longitudinal slot that permits it to be pushed toward or from the other end of the slide, and thus to carry the brass plate over the object or away from it. The whole mount is finished by covering with paper in the old style.

Mounting in Copal Varnish.—I find this varnish dries very rapidly if slightly heated, or even if placed on a previouly-warmed slide. I have many hundred slides of diatoms prepared in copal varnish, and my friend, Mr. Van Heurck, of Antwerp, who was

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

the first to use this material, has many thousands. The varnish to be used is what is called the "pale copal," and its consistency ought to be that of oil. It is much pleasanter to use than Canada balsam, does not make bubbles, and its refractive index is not very different from that of balsam, and does not interfere with the solution of diatom markings. I have of late made many preparations in copal, dispensing with the cover-glass altogether. The drop of copal is placed on the diatoms and heated lightly over the spirit-lamp. It soon takes the consistency of amber, and is hard enough to sustain wiping and brushing with a soft brush with impunity.—*Julien Deby, C. E., from the Journal of the Queckett Microscopical Club.*

Importance of Stating Magnifying Power used.—Mr. F. J. George very properly protests, in *Science Gossip*, against the vague and ambiguous phraseology used in connection with the magnified sketches of microscopic objects. Drawings which are lettered "highly magnified," "much enlarged," etc., are rendered unscientific and absurd by the very words thus used to explain them. It would be more rational, more instructive, and more satisfactory to every scientific reader, if such vague statements were replaced, in every possible instance, by a memorandum of the number of diameters by which the drawing surpasses the size of the natural object.

Columbus, Ohio, March 1, 1881.

Editor American Naturalist :

Dear Sir:—I am authorized by the president of the American Society of Microscopists to announce to its members, that the Executive Committee have decided by an almost unanimous vote, to accept the invitation received from Columbus, Ohio, and to call the next meeting of the society at that place, on Tuesday, August 9, 1981 (the week previous to the Cincinnati meeting of the American Association for the advancement of Science).

Albert H. Tuttle, *Secretary.*

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SCIENTIFIC NEWS.

— From advanced sheets of the report of Professor W. K. Brooks, Director of the Chesapeake Zoölogical Laboratory of Johns Hopkins University, we learn that by the liberality of the Trustees he was enabled to spend a much longer period than hitherto at the seaside, and was provided with a more liberal outfit, including a steam launch which was built for their use in the last spring, at Bristol, R. I., and has proved a very efficient auxiliary. The necessary books, dredges and other instruments were also provided by the University. In addition to the opportunities afforded to three of the members of their own academic staff, three other gentlemen, devoted to the study of zoölogy, were

invited to avail themselves of the scientific facilities of the station.

The laboratory was opened at Beaufort, N. C., on April 23, 1880, and closed on September 30, after a session of twenty-three weeks. It was supplied with working accommodations for the six investigators who were in attendance.

Beaufort was selected for the third season's work because it is the nearest accessible town, south of Baltimore, which is favorably situated for zoölogical study. The advantages of a location in a town are well shown by the fact that the expenses of a session of twenty-three weeks this year were considerably less than those of a ten weeks' session the year before.

The scientific advantages of Beaufort are very great; the most important is the great difference between its fauna and that of our northern Atlantic coast.

The configuration of our coast line is such that Cape Hatteras, the most projecting point south of New York, deflects the warm water of the Gulf Stream away from the coast, and thus forms an abrupt barrier between a cold northern coast and a warm southern one. The fauna north of this barrier passes gradually into that of Southern New England, while the fauna south of the barrier passes without any abrupt change into that of Florida, but the northern fauna is sharply separated by Cape Hatteras from the southern.

During the past season Dr. Brooks worked out the interesting life history of Leucifer, and Mr. Wilson that of Phoronis, which have been published in abstract in the NATURALIST.

Another interesting group which was studied is the Porcellanidæ; the least specialized of the true crabs. The adults of our American species are almost restricted to our southern waters, although the swimming larvæ are carried north by the Gulf Stream. Within the last two years two northern naturalists have studied these floating embryos upon the south coast of New England, but as they were working upon stragglers so far from home, their accounts are incomplete and somewhat contradictory. The advantages at Beaufort enabled them to contribute towards the solution of this confused subject by raising one species of Porcellana from the egg.

They also raised six other species of crabs from the egg, and made drawings of the more important stages of development. One of the species which was thus studied is the edible crab. Its metamorphosis has never been figured, and although it presents no unusual features, its economic importance gives value to exact knowledge of its life history.

Mr. Wilson also studied the development of one species of Pycnogonida, a group of very peculiar Arthropods, distantly related to the spiders. As he has paid especial attention to the systematic study of this group, and is now engaged in describing the Pycnogonids collected in the Gulf Stream by Mr. Agassiz, the

opportunity to study them alive in the laboratory has been a great advantage to him.

Another important investigation is the study, by Mr. Wilson, of the embryology of the marine Annelids. Although the representatives of this large group are abundant and widely distributed, little was known of the early stages of their development until he procured the eggs of several species and studied them at Beaufort. This investigation has shown, among other things, that the accepted division of Annelids into two great groups, the Oligochæta and Polychæta, is not a natural method of classification. The work upon the development of marine Annelids was supplementary to an investigation which Mr. Wilson carried on last spring at Baltimore, and which he will continue this winter, upon the development of land and fresh-water Annelids.

As much time as possible was given this season to the study of the hydroids and jelly-fish of Beaufort. The life history of several of them were investigated, a thorough anatomical study of some of the most important forms was carried on, and nearly two hundred drawings were made. It is almost impossible to complete a study of this kind in a single season, but if one or two more summers can be given to the work, we have every reason to hope for valuable results, for although the North Carolina coast is the home of many species which are only found as stragglers upon our northern coast, and of other species which are not known to occur anywhere else, and of some genera and families which are new to the North American coast, this field has suffered almost total neglect.

Nearly three months of the time of two members of the party, Mitsukuri and Wilson, were given to the study of the habits, anatomy and development of Renilla, a compound Polyp very much like that which forms the precious coral, but soft and without a stony skeleton. The animals which form the community are so intimately bound together that the community, as a whole, has a well marked individuality, distinct from that of the separate animals which compose it. The compound individuality of Renilla is quite rudimentary as compared with that of a Siphonophore. and as there is no trace of it in the closely allied Gorgonias, it furnishes an excellent field for studying the incipient stages in the formation of a compound organism by the union and specialization of a community of independent simple organisms. With this end in view the anatomy of the fully developed community was carefully studied, and the formation of a community was traced by rearing a simple solitary embryo in an aquarium until a perfect community had been developed from it by budding. During the process of development the law of growth by which the characteristics of the compound organism are brought about was very clearly exhibited, and it is fully illustrated by nearly one hundred drawings.

Next summer there will be room at the laboratory for ten instead of six students. The nature of the results of this and the first and second seasons' work of this laboratory certainly show that scientifically the success is all that could have been expected; and we may expect that if the institution is permanently maintained by the Trustees of the University, the results will be most creditable to American Biological Science. This department is not strong in the United States, and if the Johns Hopkins University can permanently aid in its development, with officers and students so ready to avail themselves of the privileges offered, it is to be hoped that the question of a few hundred dollars will not be an obstacle to the success of the undertaking.

— A bill establishing a Bureau of Animal Industry was reported to the Senate in February by Mr. Johnson, from the select committee on the subject of pleuro-pneumonia and other contagious diseases of domestic animals. It provides for the organization of a bureau of animal economy in the Department of Agriculture. It authorizes the Commissioner of Agriculture to appoint a Chief of this Bureau, who is a competent veterinary surgeon, approved by the National Board of Health, and whose duty it is to investigate and report the value and condition of domestic animals, and also the cause of contagious diseases among them, and provide for the prevention and cure of the same. The Commissioner is authorized by the bill to purchase and slaughter diseased animals, provided the sum paid for them shall not exceed two-thirds the market value of healthy animals, and $200,000 is appropriated to meet the expenses incurred in carrying out the provisions of the act.

— Major J. W. Powell was, a few days ago, confirmed by the Senate to fill the position of Director of the United States Geological Survey, recently vacated by Mr. King. While our preferences are for Dr. Hayden, the founder of the survey, we will hope the new occupant may be sustained by liberal congressional appropriations.

— Dr. James Lewis, the celebrated conchologist, died on the 23d February last, at his home in Mohawk, N. Y. His malady was one of long standing, and during the later years of his life caused him much suffering. Well known to most conchologists in the United States, the intelligence of his death will be received by them with deep regret. A brief sketch of his life will appear in another number.—*R. E. C.*

— On the 3d of February died the well-known English ornithologist, John Gould, F. R. S., aged 76. He was the author of "A Century of Birds from the Himalaya mountains;" "The Birds of Europe," and "The Birds of Australia," the latter in seven folio volumes and with colored illustrations of 600 species, and many other important works. He had been recently engaged on an entirely new work, "The Birds of Great Britain."

— Lithology has suffered a loss by the death of Professor Emanuel Boricky, who died in January last at Prague, aged 40 years. He was well known for his studies on the rocks and minerals of Hungary and Austria.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, Feb. 16.—Dr. C. S. Minot discussed the question of a common larval type among annelids, mollusks and vertebrates. The president spoke of the carboniferous insects of Great Britain, and Mr. Burgess remarked on the aorta in the Lepidoptera.

March 2.—Mr. Lucien Carr read a paper on sun worship among the North American Indians, and Dr. M. E. Wadsworth one on the history of Prepaleozoic geology in New Brunswick.

New York Academy of Sciences, Jan. 31.—Papers were read by Mr. B. B. Chamberlain, entitled, Studies in local mineralogy—1. A singular mineral identified; 2. Iron-coated boulders from Brooklyn; 3. The gneiss of New York island; and by Professor Newberry on our coast corals, their relations and geological work (with specimens and lantern illustrations).

Feb. 7.—Mr. A. A. Julien made a communication on the gneisses and diorites of the Greensboro' belt, North Carolina.

March 7.—Mr. G. F. Kunz described the spodumene emerald of North Carolina (Hiddenite), and exhibited specimens.

American Geographical Society, Feb. 17.—Mr. John Banvard delivered a lecture on the hierology and reading of the obelisks of Egypt, illustrated by charts, diagrams and paintings on canvas, executed from original drawings made by himself while in Egypt.

Appalachian Mountain Club, Feb. 9.—Mrs. Maria E. McKaye read a paper on Lake Dunmore.

State Natural History Society, Feb. 8.—The second annual meeting was held in the State House at Springfield, Illinois. President Worthen addressed the society on the fossil fuels of the United States. Papers and remarks on the archæology of Illinois, especially the mound-builders, were communicated by Mr. W. McAdams, Judge J. G. Henderson, Professor Cyrus Thomas and others. Mr. McAdams then read a paper on artesian wells. Mr. F. S. Earle described the cave-dwellers of Southern Illinois. Mr. W. H. Garman presented the results of studies on the gall mites (Phytopti). Professor C. Thomas remarked on the Palenque tablets. Professor Burrill discussed the subject of *Bacteria pe-menta*. Mr. D. B. Wier contributed a paper on the grape rot; while Professor Forbes read a paper entitled illustrations and application of the doctrine of evolution. Judge Henderson delivered an address entitled, The ancient Illinois, and finally Professor Forbes read a paper on the English sparrow in Germany, with notes on its autumnal food in Illinois.

SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts.—March. Structure and affinities of Euphorberia of Meek and Worthen, by S. H. Scudder. Origin of some new points in the topography of North Carolina, by W. C. Kerr.

The Geological Magazine.—February. The glaciation of the Shetland isles, by B. N. Peach. Oceanic islands, by T. M. Reade.

Annals and Magazine of Natural History. — January. *Spolia atlantica,* Contributions to the knowledge of the changes of form in fishes during their growth and development, especially in the pelagic fishes of the Atlantic, by C. F. Lütken (continued in the February number).

Bulletin of the U. S. Geological Survey of the Territories.—Vol. vi, No. 1, Feb. 11. The vegetation of the Rocky Mountain region, and a comparison with that of other parts of the world, by A. Gray and J. D. Hooker. On some new Batrachia and Reptilia from the Permian beds of Texas. On a wading-bird from the Amyzon shales, by E. D. Cope. Osteology of *Speotyto cunicularia* var. *hypogæa,* by R. W. Shufeldt. Osteology of *Eremophila alpestris,* by R. W. Shufeldt. Preliminary list of the N. A. species of Agrotis, with descriptions, by A. R. Grote. On the Nimravidæ and Canidæ of the Miocene period, by E. D. Cope. On the vertebrata of the Wind river Eocene beds of Wyoming, by E. D. Cope.

Zeitschrift für Wissenschaftliche Zoologie, Feb. 1.—On the alternations of generations of oak-gall wasps, by H. Adler. Researches on the Orthonectidæ, by E. Metschnikoff. Contribution to the knowledge of the supra-spinal cord (or ventral vessel) of the Lepidoptera, and of the central, peripheral and sympathetic nervous system of caterpillars. Especially valuable for the observations on the ventral vessel, which envelopes the abdominal portion of the abdominal nervous cord, including the last four ganglia of the imago (it does not occur in the caterpillar) of Acherontia. This vessel he found to stand in direct relation with the outer neurilemma of the ventral nervous cord, and this latter passes into the vessel. The tissue is a gelatinous connective tissue. On the pairing and reproduction of a species of Scyllium, by H. Bolau.

Jenaische Zeitschrift für Naturwissenschaft, January 25.—The Coelom-theory, attempt at an explanation of the middle germ layer, by O. and R. Hertwig. The authors give a long discussion of the subject, regarding the Cœlenterates except the Ctenophora as possessing no genuine mesoderm, they apply the term *mesenchym* to the secretory tissues corresponding to the mesoderm of the higher animals, and then discuss the origin and relations of the mesoderm in the higher animals. Contributions to the knowledge of the structure of the butterfly's tongue, by W. Breitenbach.